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PROCEEDINGS OF THE

Eighteenth Annual Convention

OF THE

AMERICAN RAILWAY
BRIDGE AND BUILDING ASSOCIATION

Successor to the
ASSOCIATION OF RAILWAY SUPERINTENDENTS OF
BRIDGES AND BUILDINGS

HELD IN

WASHINGTON, D. C.

OCTOBER 20, 21 AND 22, 1908

CONCORD N. H.
RUMFORD PRINTING CO.
1908

The Nineteenth Annual Convention of the American Railway Bridge and Building Association will be held at Jacksonville, Florida, October 19-21, 1909

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OFFICERS FOR 1908-1909.

John P. Canty . . . . President
Boston & Maine Railroad, Fitchburg, Mass.

H. Rettinghouse . . . . . . First Vice-President
Chicago & North Western Railway, Boone, Ia.

F. E. Schall . . . . Second Vice-President
Lehigh Valley Railroad, South Bethlehem, Pa.

J. S. Lemond . . . . Third Vice-President
Southern Railway, Charlotte, N. C.

A. E. Killam . . . . Fourth Vice-President
Intercolonial Railway, Moncton, N. B.

S. F. Patterson . . . . Secretary
Boston & Maine R. R., Concord, N. H.

C. P. Austin . . . . Treasurer
Boston & Maine R. R., Medford, Mass.

EXECUTIVE MEMBERS.

J. N. Penwell . . . . Tipton, Ind.
Lake Erie & Western Railway.

Willard Beahan . . . . Cleveland, Ohio
Lake Shore & Michigan Southern Railway.

F. B. Scheetz . . . . St. Louis, Mo.
Missouri Pacific Railway.

W. H. Finley . . . . Chicago, Ill.
Chicago & North Western Railway.

T. L. D. Hadwen . . . . Chicago, Ill.
Chicago, Milwaukee & St. Paul Railway.

T. J. Fullem . . . . Chicago, Ill.
Illinois Central Railroad.

PAST PRESIDENTS.

O. J. TRAVIS . . . . Fort Worth, Tex.
Fort Worth & Denver City Railway.

*H. M. Hall . . . . Olney, Ill.
Ohio & Mississippi Railway.

*J. E. WALLACE . . . . Springfield, Ill.
Wabash Railroad.

GEO. W. ANDREWS . . . . Mt. Royal Station, Baltimore, Md.
Baltimore & Ohio Railroad.

W. A. McGONAGLE . . . . Duluth, Minn.
Duluth, Massabe & Northern Railway.

JAMES STANNARD . . . . Moberly, Mo.
Wabash Railroad.

*WALTER G. BERG . . . . New York City, N. Y.
Lehigh Valley Railroad.

J. H. CUMMIN . . . . Jamaica, N. Y.
Long Island Railroad.

*AARON S. MARKLEY . . . . . . Danville, Ill.
Chicago & Eastern Illinois Railroad.

WALTER A. ROGERS . . . . 355 Dearborn St., Chicago, Ill.

WILLIAM S. DANES . . . . Peru, Ind.
Wabash Railroad.

B. F. PICKERING . . . . Sanbornville, N. H.
Boston & Maine Railroad.

ARTHUR MONTZHEIMER . . . . Joliet, Ill.
Elgin, Joliet & Eastern Railway.

C. A. LICHTY . . . . Chicago, Ill.
Chicago & North Western Railway.

J. B. SHELDON . . . . Providence, R. I.
New York, New Haven & Hartford Railroad.

J. H. MARKLEY . . . . Peoria, Ill.
Toledo, Peoria & Western Railway.

R. H. REID . . . . Cleveland, Ohio
Lake Shore & Michigan Southern Railway.

* Deceased.

COMMITTEES FOR 1908-1909.

COMMITTEES ON SUBJECTS FOR REPORT AND DISCUSSION.

I. Various Methods of Carrying Electric Transmission Wires over Railway Tracks and Best Way to Protect Tracks and Company Wires.

W. A. Pettis, N. Y. C. & H. R. R. R., Rochester, N. Y.
J. Van der Hoek, L. V. R. R., Buffalo, N. Y.
G. A. Mitchell, G. T. R. R., Toronto, Ont.
J. T. Webster, Mich. Cent. R. R., St. Thomas, Ont.
E. J. Govern, 939-943 Granite Bldg., Rochester, N. Y.

II. Inspection of Bridges and Buildings; Blanks to be Used; Method of Inspection; Frequency, etc.

Lee Jutton, C. & N. W. Ry., Chicago, Ill.
H. H. Eggleston, T., St. L. & W. R. R., Frankfort, Ind.
F. O. Draper, Ill. Cent. Ry., Chicago, Ill.
Henry Bender, Wis. Cent. Ry., Fond du Lac, Wis.

III. Best Organization for a Railway Bridge and Building Department.

F. B. Scheetz, Mo. Pac. R. R., St. Louis, Mo.
J. M. Wells, A. T. & S. F. Ry., Chillicothe, Ill.
W. B. Causey, C. G. W. Ry., Chicago, Ill.
W. Hurst, C. B. & Q. R. R., St. Joseph, Mo.
R. J. McKee, Ill. Cent. R. R., Freeport, Ill.

IV. Water Stations and Water Supply.

P. Swenson, M., St. P. & S. Ste. M. Ry., Minneapolis, Minn.
C. E. Thomas, Ill. Cent. R. R., Chicago, Ill.
B. T. McIvers, D. & I. R. R. R., Two Harbors, Minn.
C. A. Lichty, C. & N. W. Ry., Chicago, Ill.

V. Turntables: Design, Length and Power for Operating Them.

A. W. Merrick, C. & N. W. Ry., Boone, Ia.
T. J. Fullem, Ill. Cent. R. R., Chicago, Ill.
D. C. Zook, P. R. R., Fort Wayne, Ind.
A. A. Wolf, C., M. & St. P. Ry., Milwaukee, Wis.
H. A. Horning, Mich. Cent. R. R., Jackson, Mich.

VI. Design of Material Yards, Platforms and Sheds.

D. L. McKee, P. & L. E. R. R., McKees Rocks, Pa.
F. Ingalls, N. P. R. R., Jamestown, N. D.
J. D. Gilbert, A., T. &. S. F. R. R,, Topeka, Kan.
W. E. Alexander, B. & A. R. R., Houlton, Me.
H. M. Henson, P. O. Box 875, Beaumont, Tex.

VII. Design of Portable Derrick and Push Car for Same.

James Dupree, Southern Ind. Ry., Crete, Ill.
A. B. McVay, L. & N. R. R., Evansville, Ind.
E. P. Hawkins, St. L. I. M. & S. Ry., Ferriday, La.
H. Rettinghouse, C. & N. W. Ry., Boone, Ia.

VIII. Best Method of Housing Railway Bridge and Construction Gangs.

B. F. Pickering, B. & M. R. R., Sanbornville, N. H.
A. F. Miller, P. R. R., Chicago, Ill.
J. M. Staten, C. & O. R. R., Richmond, Va.
A. McNab, P. M. R. R., Holland, Mich.

IX. Pile and Frame Trestle Bridges.

A. H. King, O. S. L. R. R., Salt Lake City, Utah.
J. F. Parker, A., T. & S. F. Ry., San Bernadino, Cal.
W. T. Powell, C. & S. Ry., Denver, Col.
B. J. Mustain, E. P. & N. E. R. R., El Paso, Tex.
L. D. Smith, S. P. Co., Oakland, Cal.

X. Docks and Wharves, Including Appliances for Transferring Cars from Wharves to Floating Equipment and Best Method of Wheeling Freight from Dock House to Boats at Various Stages of Water.

F. E. Schall, L. V. R. R., So. Bethlehem, Pa.
Austin Lord Bowman, 165 Broadway, New York City.
F. A. Knapp, Erie R. R., Jersey City, N. J.
J. P. Snow, B. & M. R. R., Boston, Mass.
E. E. Wilson, N. Y. C. & H. R. R. R., New York City.

XI. Railway Engine House Construction.

E. G. Storck, P. & R. Ry., Philadelphia, Pa.
S. C. Tanner, B. & O. R. R, Cumberland, Md.
W. E. Harwig, L. V. R. R., Phillipsburg, N. J.
John Ewart, B. & M. R. R., Boston, Mass.

XII. Painting: Best Paint to Use; Effect of Salt Water; Use of Compressed Air in Painting and Cleaning Iron.

A. B. Hubbard, B. & M. R. R., Boston, Mass.
R. P. Mills, N. Y. C. & H. R. R., New York City.
H. E. Holmes, Cent. Vt. R. R., New London, Conn.
J. E. Johnson, Rutland R. R., Rutland, Vt.
G. Aldrich, N. Y., N. H. & H. R. R., Readville, Mass.

Proceedings of the Eighteenth Annual Convention
OF THE
American Railway Bridge and Building Association

HELD IN WASHINGTON, D. C., OCTOBER 20, 21 AND 22, 1908

MORNING SESSION.

TUESDAY, October 20, 1908.

The eighteenth annual convention was called to order at 10.15 o'clock a. m. by President R. H. Reid, in the assembly room of the Arlington Hotel, Washington, D. C., Tuesday, October 20, 1908.

President.—I will ask all present to arise while Brother J. H. Cummin leads us in prayer.

Prayer was then offered by Mr. Cummin.

President.—We are fortunate in having with us this morning to address the Association and extend a welcome to us Mr. Henry B. F. Macfarlane, president of the Board of Commissioners of the District of Columbia. I may say in this connection that Congress enacts all laws for the District of Columbia, which are administered by the Board of Commissioners of which Mr. Macfarlane is president. This differs greatly from the ordinary city administration.

Mr. Macfarlane.—I am very happy to be allowed to offer a welcome on behalf of the government of the District of Columbia. As your President has stated, it is not an ordinary city government; it is extraordinary, unique, peculiar; and yet if you stay here long enough I think you will agree with me that it is a very satisfactory government for us. We are very glad to see the members of this

Association, especially as you brought the ladies with you, as they are a guarantee that you will enjoy the freedom of Washington, and we will moreover feel sure that the freedom of the city is safe while they are here.

I am surprised and amazed to find that this Association has never met in Washington before, although I am told that it is eighteen years old. Now that it has arrived at years of discretion it has evidently found that Washington is the place to meet, and I sincerely trust that you may hold at least every other meeting in Washington. It is perhaps too much to ask that you hold every annual meeting here, because we know that you are wanted in many cities, but I think that after this meeting you will all want to come back at least every other year. We are very glad to know that some of the Canadian members of the Association are here, because we in Washington have a very friendly feeling towards our Canadian brothers. Many of us have enjoyed the hospitality of Canada at one time or another and are only too glad to return the compliment; naturally, however, we of Washington have a very special welcome for you who are of the United States, because this is our capital—yours and ours; it does not belong to the 330,000 who live here, although we are allowed to pay one-half of the expenses; we each pay about $16 per year, and you about six cents, but still we admit you as tenants in common in the District of Columbia. We are glad to have you here because we wish you to see the progress which has been made, to get some idea of all that has been accomplished in the upbuilding and beautification of the capital, so that you may take a new, intelligent and patriotic interest in it.

Every American citizen wants this to be the best capital on earth, and we want you to learn while you are here that you can be of very great service in speaking to your senators and representatives and upholding them in the carrying out of their plans for its betterment. We shall contribute next year about $6,000,000 and you will contribute

$6,000,000 more, under the organic act of the District of Columbia. You are naturally interested and we want you to be more interested in the expenditure of that money and in all plans for the future development of Washington. Probably the Union Station was new to most of you and all that remarkable terminal work. It was a great man, President Cassatt, who had more to do than any other man in making that station monumental and worthy of the capital for all time to come. We are very proud of all the terminal work that has been done. We have also something in the way of bridges to show you; some of them are ugly ones, as you may have noticed, but some of them are beautiful, and I hope that you will all see the bridge across Rock Creek at Connecticut Avenue. I trust that your deliberations may be profitable for the great purpose you have in view, and which interests all of us; we laymen may not be able to understand the technique of your business, but we do appreciate the results. It is to the honor of America that your work on the whole has been such as to command the admiration of the world. You may go on for years without getting any particular praise from any quarter except from your road, and it is perhaps well to hear someone say for the traveling public, as I say, that the hidden work that is done by the engineers of the railroads of the United States is appreciated thoroughly. It is a soldierly work that you are doing, like the old time pioneers going ahead and making the paths straight for the progress of civilization and humanity. We hope that you will enjoy your visit and come back year after next at the latest. (Applause.)

President.—We are very glad to hear from Mr. Macfarlane and are, of course, interested in his appreciation of the work done by bridge and building men generally. I will ask Mr. Willard Beahan of the L. S. & M. S. Ry. to express the appreciation of the Association for Mr. Macfarlane's remarks.

Mr. Beahan.—Mr. President, Ladies and Gentlemen: On behalf of the Association I wish to express the gratitude which we feel towards the Board of Commissioners of the District of Columbia so feelingly and so happily expressed by its president this morning. We are here because we are men of parts: part business, part pleasure; and we have brought our wives and best girls with us to enjoy this great capital city. This is indeed our eighteenth meeting and we are somewhat ashamed that it is our first gathering as an Association in the city of Washington. I cannot explain it; I do not know that it needs an explanation, but I think it will certainly need an explanation in the future if we do not come more than once in the next eighteen years. Of course, we also receive a hearty welcome from other cities; in Chicago they tried to sell us the Masonic Temple, and I presume it will be the same way here with the Washington monument. I have, by the way, inspected the Washington monument, and cannot understand (as an engineer, of course), why the newer part of that monument is the lower part. (Laughter.) On the Northwestern Road a superintendent wanted to know how we were "going to rebuild that bridge," and asked quite a number of foolish questions; finally one of the engineers told him we were going to use "sky hooks," and the answer satisfied him perfectly. I am also going to inspect the Soldiers' Home carefully, because that is where we may be entitled to spend our declining years, since we certainly intend to do a little "soldiering" later on in this meeting. We are of course, not here entirely for business; we are wiser than that; this is our recreation time. We are here in a larger capacity with our families, and wish to improve ourselves as citizens at the same time that we improve ourselves as bridge men. The beauty of your city, the wideness of its avenues and the charm of its vistas must make an impression on the minds of all of us. "Beauty and truth go hand in hand," as we read in your library building last night, and certainly such beautiful scenes must broaden our minds and make us better men and women. We have visited other cities, but it is to Washington, I think, that we must come for the higher inspiration, since we wish not only to be good bridge men and good citizens of various states, but also good citizens of the republic. As regards our future visits to Washington, I may perhaps better illustrate our position by a little story: Bishop Brooks, that great New England bishop, some years ago had a small boy call upon him with a basket full of puppies which he had for sale. The bishop was not inclined to buy and finally the little boy said, "Bishop, you ought to buy one of these puppies, for they are good Episcopalian puppies." The bishop thought that was a pretty good retort and spread the story among his brethren. About a week later the boy called at the home of the Presbyterian minister with puppies for sale, mentioning among other good qualities that they were Presbyterian puppies. "See here," said the Presbyterian minister, with mock severity, "aren't you the same boy who called on Bishop Brooks about a week ago, and aren't these the same puppies which you tried to sell him for Episcopalian puppies?" "Yes," said the little boy, "but they's got their eyes open now." (Laughter.) Now, my brothers and sisters, we have been in Chicago, Boston and other cities. During this week in Washington I hope that we will get our eyes opened, and that because of our visit here we will all be better men and women and better American citizens. (Applause.)

President.—Mr. W. J. Douglas, engineer of bridges for the District of Columbia, who has designed the bridges and had charge of their erection, and who in a general way has charge of the monumental work in the District, has kindly consented to address us on "Some Points of Interest in and Around Washington." I hope that his address will help the members to get an idea of what to see and how to locate the points of interest.

Mr. Douglas then gave a very able and interesting address illustrating his remarks with a large wall map of Washington and environments, and bringing out many points of great historical interest. He made very frequent references to the wall map, so that no printed report of his address would be of value without a map, which unfortunately cannot be reproduced here.

President.—I am sure we all appreciated the address of Mr. Douglas and it will be of material assistance to us in getting to the various points and seeing the places of real interest.

President.—The next order of business is the roll call, which is covered by a system of registration. Cards for the purpose will be found in the rear of this hall and all are urged to fill them out and hand them to the Secretary. In this way we can get the names, titles and locations of our members and the roads with which they are connected in better shape than by calling the roll.

MEMBERS PRESENT.

ALDRICH, GROSVENOR, N. Y., N. H. & H. R. R., Readville, Mass.
ALEXANDER, W. E., Bangor & Aroostook Railroad, Houlton, Me.
ANDERSON, L. J., C. & N. W. Ry., Escanaba, Mich.
ANDREWS, GEO. W., Asst. Engr. M. of W., B. & O. R. R., B. & O. Building, Baltimore, Md.
ASHBY, E. B., Chf. Eng., L. V. R. R., 143 Liberty St., New York City.
AUSTIN, CYRUS P., Boston & Maine R. R., Medford, Mass.
BEAHAN, WILLARD, Asst. Engr., L. S. & M. S. Ry., Cleveland, Ohio.
BROWN, J. B., K. C., C. & S. Ry., Clinton, Mo.
BROWNE, J. S., Div. Engr., N. Y., N. H. & H. R. R., Providence, R. I.
BRUCE, ROBERT J., Mo. Pac. Ry., 807 Mo. Pac. Bldg., St. Louis, Mo.
BURKE, J. T., Chief Engr., Liberty White R. R., McComb, Miss.
BURPEE, MOSES, Chief Engr., Bangor & Aroostook R. R., Houlton, Me.
CANTY, JOHN P., Fitchburg Div., B. & M. R. R., Fitchburg, Mass.
CARPENTER, JAMES T., St. Louis Div., Southern Ry., Princeton, Ind.
CLEAVELAND, H. D., Bessemer & Lake Erie R. R., Greenville, Pa.
EWART, JOHN, B. & M. R. R., North Union Station, Boston, Mass.
FULLEM, T. J., Ill. Cent. R. R., 7346 Madison Ave., Chicago, Ill.
GEARY, SYLVESTER, Penn. Lines W. of Pitts., Cambridge, O.
HARWIG, WILLIAM E., Lehigh Valley R. R., Phillipsburg, N. J.
HAUSGEN, F. W., Mo. Pac. R. R., Pacific, Mo.
HIGGINS, H. K., Asst. Engr., Panama Canal, Cristobal, Canal Zone.

Hofecker, Peter, Lehigh Valley R. R., Sayre, Pa.
Hopke, W. T., B. & O. R. R., Grafton, W. Va.
Horn, U. A., Mo. Pac. R. R., Osawatomie, Kan.
Hubbard, Andrew B., Boston & Maine R. R., Boston, Mass.
Huncikeb, John, C. & N. W. Ry., Chicago, Ill.
Joslin, Judson, L. V. R. R., Auburn Div., Auburn, N. Y.
Jutton, Lee, Asst. Gen. Inspector, C. & N. W. Ry., Chicago, Ill.
Keefe, David A., Lehigh Valley R. R., Athens, Pa.
Keith, Herbert C., 1508 Hanover Bank Bldg., New York City.
Kelly, C. W., Fairbanks, Morse & Co., Chicago, Ill.
Killam, A. E., Gen. Insp., Intercolonial Ry., Moncton, N. B.
King, A. H., Oregon Short Line R. R., Salt Lake City, Utah.
King, Chas. F., C. & N. W. Ry., Norfolk, Neb.
King, F. E., Asst. Engr., C., M. & St. P. Ry., Milwaukee, Wis.
Large, C. M., Penn. Lines W. of Pitts., Jamestown, Pa.
Lemond, J. S., Engr., M. of W., Southern Ry., Charlotte, N. C.
Lichty, C. A., Gen. Insp., C. & N. W. Ry., Chicago, Ill.
Markley, Aaron S., Chicago & Eastern Ill. R. R., Danville, Ill.
Markley, John H., Toledo, Peoria & Western Ry., Peoria, Ill.
McKee, D. L., Pittsburg & Lake Erie R. R., McKee's Rocks, Pa.
McKeel, W. S., G. R. & I. Ry., Grand Rapids, Mich.
McKibbon, Robert, P. R. R., 30th St., S. Side, Pittsburg, Pa.
Miller, A. F., Penn. Lines West of Pitts., 38 W. Van Buren St., Chicago, Ill.
Montzheimer, Arthur, Chief Engr., E., J. & E. Ry., Joliet, Ill.
Morgan, J. W., Southern Ry., Columbia, S. C.
Musser, D. G., P. R. R., Wellsville, O.
Noon, W. M., Duluth, So. Shore & Atlantic Ry., Marquette, Mich.
Page, Adna A., Boston & Maine R. R., Boston, Mass.
Parks, J., Union Pacific R. R., Room 26, Union Depot, Denver, Col.
Patterson, Samuel F., Boston & Maine R. R., Concord, N. H.
Penwell, John N., L. E. & W. Ry., Tipton, Ind.
Perry, W. W., Phila. & Reading Ry., 147 Market St., Williamsport, Pa.
Powell, W. T., Colorado & Southern R. R., Denver, Col.
Reid, R. H., L. S. & M. S. Ry., Cleveland, Ohio.
Richey, C. W., Penn. Lines, 217 Union Station, Pittsburg, Pa.
Riney, M., C. & N. W. Ry., Baraboo, Wis.
Rodman, George A., N. Y., N. H. & H. R. R., Providence, R. I.
Schall, Frederick E., Bridge Engr., Lehigh Valley R. R., South Bethlehem, Pa.
Scheetz, F. B., Engr. of Bridges, Mo. Pac. R. R., St. Louis, Mo.
Sheldon, J. B., N. Y., N. H. & H. R. R., Providence, R. I.
Staten, Joseph M., Insp., Chesapeake & Ohio Ry., Richmond, Va.

Steffens, **Wm. F.**, **Engr. of B. and B., South & Western Ry., Johnson City, Tenn.**
Storck, **E. G., P. & R. Ry., 9th St. and Columbia Ave., Philadelphia, Pa.**
Swenson, **P., M., St. P. & S. Ste. M. Ry., Minneapolis, Minn.**
Sweeney, **William, C. & N. W. Ry., Fond du Lac, Wis.**
Walden, **H. A., C. & N. W. Ry., Boone, Ia.**
Watson, **P. N., Maine Central R. R., 5 Noble St., Brunswick, Me.**
Weise, **Fred E., C., M. & St. P. Ry., 1359 Railway Exchange, Chicago, Ill.**
Welker, **George W., Southern Ry., Alexandria, Va.**
Wells, **J. M., A., T. & S. F. Ry., Chillicothe, Ill.**
White, **J. B., C. & N. W. Ry., Boone, Ia.**
Zinsmeister, **E. C., B. & O. R. R., Zanesville, O.**
Zook, **D. C., Penn. Lines West of Pittsburg, Ft. Wayne, Ind.**

LIFE MEMBERS.

Crane, Henry, C. & N. W. Ry., Janesville, Wis.
Cummin, Joseph H., Bay Shore, N. Y.
Fletcher, Holland W., 1813 Termon Ave., Allegheny, Pa.
Morrill, H. P., C. & N. W. Ry., Madison, Wis.
Vandegrift, C. W., C. & O. Ry., Ronceverte, W. Va.
Walden, W. D., C. & N. W. Ry., Clinton, Ia.

The following applicants for membership, subsequently elected, were also present:

Auge, E., Jr., C. M. & St. P. Ry., Wells, Minn.
Beard, Amos H., P. & R. Ry., Reading, Pa.
Bibb, J. M., L. & N. R. R., Birmingham, Ala.
Barton, M. M., Penn. R. R., West Philadelphia, Pa.
Cahill, M. F., Seaboard Air Line Ry., Jacksonville, Fla.
Carter, E. M., Tenn. Cent. R. R., Nashville, Tenn.
Dupree, James, Southern Indiana Ry., Crete, Ill.
Grover, Oscar L., C. & O. Ry., Richmond, Va.
Killian, Joseph A., Jr., Southern Railway, Charlotte, N. C.
Large, H. M., G. R. & I. Ry., Ft. Wayne, Ind.
Moen, J. D., C. & N. W. Ry., Boone, Iowa.
Rhoads, John, C. & N. W. Ry., Chicago, Ill.
Spencer, Wm., C. & N. W. Ry., Chardon, Neb.
Spencer, C. H., Washington Ter. Co., Washington, D. C.
Spencer, C. F., L. I. R. R., Jamaica, N. Y.
Strouse, W. F., B. & O. R. R., Union Station, Washington, D. C.
Winter, J. L., Seaboard Air Line, Waldo, Fla.
Wright, C. W., L. I. R. R., Jamaica, N. Y.

President.—Next in order is the reading of the minutes of the last meeting.

Mr. Canty.—As the minutes of the last meeting were printed in the Proceedings, I move that their reading be dispensed with.

Motion duly seconded and carried.

President.—Next is the report of the Committee on Membership.

Mr. C. A. Lichty then presented the following report:

REPORT OF MEMBERSHIP COMMITTEE.

To the Officers and Members of the Association of Railway Superintendents of Bridges and Buildings:

The Membership Committee has for several years made no other report than that of submitting names for membership at each convention. We offer herewith a few statistics in relation to membership and methods used in inviting others to join.

From the years 1892 to 1902 the membership varied and gradually increased from 112 to 171. Since 1902 it has steadily increased until we now have an enrollment of 341 members, from over one hundred railroads, representing upwards of 182,000 miles of road in the United States, Canada, Mexico, Australia and New Zealand. The past few years we have averaged a yearly increase of about 35, which is approximately 10% of the membership, and we lose about the same number on account of deaths, resignations and delinquents.

For several years past we have issued a small four-page circular, about two months in advance of the convention, the first page giving the title of the Association and list of officers; the two inside pages setting forth the objects and aims of the Association, with detailed information for the prospective member, and on the back page a list of subjects to be reported upon and discussed at the convention.

These have been regularly sent to officers of the various railroads throughout the country who might be interested in our work and were not members—about 600 each year. This is about the only way we have of issuing an invitation to outsiders, except by personal work of the members, and the results obtained since this method has been in vogue proves that it pays to advertise. The Committee has been aided greatly by members sending in the names of applicants and prospective members and urges the coöperation of members in furnishing names of those who might join and do a little personal work in this line.

A number of the larger roads do not show in their lists of officers the names of the men in charge of bridge and building work on their line, and it is often difficult for the Committee to get the names of such.

The Chicago & Northwestern Railway stands first on the list, with 34 members; Boston & Maine, 15; Missouri Pacific, 12; Chicago, Milwaukee & St. Paul, 11; Atchison, Topeka & Santa Fé, Illinois Central, Lehigh Valley, New York, New Haven & Hartford and Southern Pacific, 10 each; Baltimore & Ohio and New York Central & Hudson River, 9; Intercolonial 8, and Northern Pacific 7.

The following is a list of names submitted for membership at this meeting, all of which after careful investigation are recommended for election:

E. J. Auge, chief carpenter, C. M. & St. P. Ry., Wells, Minn.
D. A. Ballenger, roadmaster, Southern Ry., Greenville, S. C.
M. M. Barton, master carpenter, Pennsylvania R. R., West Philadelphia, Pa.
Amos H. Beard, foreman carpenter, Phila. & Reading Ry., Reading, Pa.
J. M. Bibb, Supvr. B. and B., Louisville & Nashville R. R., Birmingham, Ala.
Samuel C. Bowers, master carpenter of bridges, P. C. C. & St. L. Ry., Steubenville, Ohio.
Stanton Bowers, master carpenter, P. C. C. & St. L. Ry., Bradford, Ohio.
F. D. Chase, architect, Ill. Cent. R. R., Chicago, Ill.
W. M. Cardwell, master carpenter, Washington Term. Co., Washington, D. C.
E. M. Carter, Supt. B. and B., Southern Ry., Tennessee Central Ry., Nashville, Tenn.
M. F. Cahill, master carpenter, Seaboard Air Line, Jacksonville, Fla.
G. W. Detter, Supvr. B. and B., Southern Ry., Charleston, S. C.
H. H. Decker, Div. Engr., C. & N. W. Ry., Winona, Minn.
James Dupree, foreman W. S., etc., Southern Indiana Ry., Crete, Ill.
T. H. Durfee, foreman B. and B., C. & N. W. Ry., Huron, So. Dak.
Richard G. Develin, Asst. Engr. M. W. Br. & Struc., Penn. R. R., Broad St. Station, Philadelphia, Pa.
George Fenney, master carpenter, C. B. & Q. Ry., McCook, Neb.
C. H. Fisk, Engr. M. of W., Frisco Lines, Beaumont, Tex.
J. R. Fowlkes, roadmaster, Southern Ry., Columbia, S. C.
W. F. Fraylick, roadmaster, Southern Ry., Charleston, S. C.
O. L. Grover, Asst. Engr., Chesapeake & Ohio, Richmond, Va.
B. F. Gehr, master carpenter, P. C. C. & St. L. Ry., Richmond, Ind.
Jas. Gratto, Asst. Engr., Southern Pac. Ry., Los Angeles, Cal.
Jos. A. Killian, Jr., Asst. Engr., Southern Ry., Charlotte, N. C.
H. M. Large, master carpenter, Grand Rapids & Ind. Ry., Ft. Wayne, Ind.
E. L. Loftin, Supr. B. & B., Queen & Crescent Route, Vicksburg, Miss.
Harry James, Gen. foreman B. and B., Colorado & Southern, Denver, Col.
H. D. Holdridge, Supr. B. and B., Yazoo & Mississippi Valley Ry., Vicksburg, Miss.
R. E. Gaut, Engr. B. and B., Illinois Central R. R., Chicago, Ill.
G. A. Manthey, Gen. foreman B. and B., Wisconsin Central Ry., Abbottsford, Wis.
John Marsh, Gen. foreman, Boston & Maine R. R., Lawrence, Mass.

JOHN D. MOEN, foreman B. and B., C. & N. W. Ry., Boone, Ia.
GEO. F. MORSE, Asst. Engr., Central R. R. of N. J., New York City.
C. W. WRIGHT, Supvr. bridges, Long Island R. R., Jamaica, N. Y.
C. F. SPENCER, master carpenter, Long Island R. R., Jamaica, N. Y.
JAS. E. NELSON, master carpenter, Great Northern Ry., Sioux City, Ia.
HENRY H. POLLOCK, master carpenter of buildings, P. C. C. & St. L. Ry., Carnegie, Pa.
WM. QUINN, master carpenter, St. Louis So. Western Ry., Tyler, Texas.
LEWIS A. RILEY, 2ND, engineer, Lehigh & Hudson River Ry., Warwick, N. Y.
JOHN RHOADS, fire inspector, Chicago & Northwestern Ry., Chicago, Ill.
W. SHROPSHIRE, Supvr. B. and B., Yazoo & Mississippi Valley R. R., Greenville, Miss.
WM. SPENCER, foreman B. and B., C. & N. W. Ry., Chadron, Neb.
C. H. SPENCER, engineer, Washington Terminal Co., Washington, D. C.
W. F. STROUSE, Asst. Engr., B. & O. R. R., Washington, D. C.
WM. SULLIVAN, Supvr. B. and B., Mo. Pacific, Kansas City, Mo.
J. L. WINTER, master carpenter, Seaboard Air Line Ry., Waldo, Fla.
F. L. THOMPSON, Asst. Engr. B. and B., Illinois Central R. R., Chicago, Ill.
WM. TRAPNELL, Div. Engr., B. & O. R. R., Baltimore, Md.

Respectfully submitted,

C. A. LICHTY,
Committee.

Mr. Penwell.—I move that the report be accepted and that the Secretary be authorized to cast one ballot for the election of the new members proposed.

The motion was duly seconded and carried and the Secretary in accordance therewith cast one ballot and the applicants were declared duly elected members of and entitled to all the rights and privileges of the Association.

Recess was then taken, giving an opportunity to meet the new members present, after which the meeting was again called to order by the president.

President.—The next in order is an address by the President. It has been impossible for me to get up anything which can properly be called an address, although there are a few points which I would like to bring out. One is in regard to the position of the railway superintendent of bridges and buildings, which is one of great importance, and carries with it an increasing responsibility on account of the increase in weight of cars and other equipment; of more rapid deterioration of structures because of smoke, dripping brine, etc., and because, as the country grows up, the traffic is denser, and conditions generally become more strenuous. The position probably carries as great a responsibility as any on a railroad; the superintendent must keep his bridges in order without interruption to traffic, and must not spend any money unnecessarily. This has been especially the case during the recent business depression, and while I do not think any of you have been called to go beyond the limit of safety, yet we were compelled to keep pretty close to that line. A bridge superintendent is always on duty. The old proverb runs, "A man works from sun to sun; but woman's work is never done." The superintendent not only works from sun to sun, but also through the night; his 'phone is likely to ring at any time calling him to attend to matters, not only under his jurisdiction, but frequently those over which he has no control; in that way he is always on duty. The bridge and building superintendent has to keep in touch with all other departments, for if there is friction or lack of harmony anywhere it causes delay and friction and trouble all along the line. He must be loyal, representing his own company first of all, yet seeing that other companies are fairly treated, keeping accounts accurately and seeing that all companies get what they pay for.

Another point: the question has been raised from time to time as to the relative efficiency of the technical man and the practical man. Sometimes we hear it said that one should be a technical man to hold the position of superintendent of bridges and buildings, but in my opinion this is not necessary; the superintendent of bridges and buildings must be first of all a practical man; a railroad wants a man of some experience. If, with that, they can get a man with a technical education, so much the better, but if it becomes a question of choice between a technical man without experience or an experienced man without technical education, I think the railroad would choose the man with experience. It follows therefore that as members of the Association grow older there is no need of becoming discouraged on account of their age, because though a man may be 60 or 70 years old, he is still valuable to his company, and while he may not be able to go about as actively as a younger man, yet he has experience regarding the structures under his care and knowledge of their history that no other man possesses. Sometimes things come up that may cause great expense to his company if there is no one who is familiar with the past history of structures and locations.

Another point, and one which perhaps concerns us as an Association, is the advisability of attending the meetings of this Association. I want to urge on all our members the advisability of their attendance at our meetings, and this applies also to others not members of the Association who are superintendents of bridges and buildings or engaged on that work. In the case of a wreck, emergency or serious trouble, a man does not always have the Proceedings with him to tell him what the other fellow has done in a similar case, but if he has attended the meetings he has in mind what has been done and knows what to do at a minute's notice.

With these thoughts I will close and take up the next in order, which is the report of the Executive Committee.

REPORT OF EXECUTIVE COMMITTEE.

Concord, N. H., Oct. 19, 1908.

To the Officers and Members of the Association of Railway Superintendents of Bridges and Buildings:

Gentlemen: The Executive Committee have held three sessions during the year, the usual routine business was transacted and the general welfare of the Association was considered.

Messrs. C. A. Lichty, A. Montzheimer and A. S. Markley were appointed a committee to revise the Constitution and By-Laws and submit a report to this convention for consideration and action. The proposed amendments were submitted to the members

CR.

By cash paid out, for which I hold vouchers..........	$2,463.65
Balance in my hands...........................	$246.73

Respectfully submitted,
S. F. PATTERSON,
Secretary.

Mr. A. E. Killam.—I move that the report be accepted and referred to the Auditing Committee and printed in the Proceedings.

Motion was duly seconded and carried.

The Secretary then read a letter from Mr. H. Rettinghouse, expressing his regret at being unable to attend the meeting of the Association.

President.—I will ask the Secretary to acknowledge the letter and express our appreciation to Mr. Rettinghouse for his interesting letter.

Letters of regret were also received from the following members: H. H. Eggleston of the T., St. L. & W.; W. O. Eggleston of the C. & E.; James McIntyre; James F. Carpenter of the Southern Railway; S. D. Bailey of the M. C. R. R.; R. O. Elliott of the L. & N.; O. J. Travis; F. Ingalls of the Northern Pacific; J. W. Anderson of the C., H. & D.; W. A. McGonagle of the D., M. & N.; James Fraser of the New South Wales Government Railway; James Stannard; K. J. C. Zinck of the Grand Trunk Pacific; Geo. E. Hanks of the Pere Marquette; H. M. Henson and G. M. Manthey, Wisconsin Central Railway.

President.—Next in order is the annual report from the Treasurer.

REPORT OF TREASURER.

LAWRENCE, MASS., October 19, 1908.

To the Officers and Members of the Association of Railway Superintendents of Bridges and Buildings:

GENTLEMEN: Your Treasurer submits the following report for the year ending October 20, 1908:

DEBIT.

Cash on hand last report		$1,020.02
Interest to May 2, 1908		38.59
On deposit in Medford Savings Bank, Medford, Mass.		$1,058.61
July, 1908, received from Secretary	$300.00	
Deposited in Broadway Savings Bank, Lawrence, Mass.		300.00
Total on deposit		$1,358.61

Respectfully,

C. P. AUSTIN,
Treasurer.

Mr. A. S. Markley.—I move that the report be referred to the Auditing Committee and printed in the Proceedings.

Motion was duly seconded and carried.

President.—Next in order is the report from the Committee on Memoirs.

REPORT OF COMMITTEE ON MEMOIRS.

SANBORNVILLE, N. H., October 16, 1908.

To the Officers and Members of the Association of Railway Superintendents of Bridges and Buildings:

GENTLEMEN: Once more it becomes our sad duty to submit to your attention a brief outline of the lives of those of our members who have during the past year been called from the busy walks of life here to the rest and reward of all who are faithful to the trust committed to them in this life.

We realize all too forcibly that any words of ours must at best but feebly express the feelings of love and admiration we hold for these, our deceased brothers. Our pen will fail utterly to do justice to the noble lives they lived, but our hearts are most tender as we remember them and the loved ones they left to mourn their loss. While we sincerely mourn with them, let us rejoice that the lives our brothers lived were such as to be well worthy of imitation, and the records they left prove them to have been entitled to our love and respect. To their loved ones we would extend our most heartfelt sympathies.

We would recommend that a copy of these memoirs be sent to the friends they left behind, and also be published in the Proceedings of this convention, with the following memoirs respectfully submitted.

B. F. PICKERING,
Committee.

MEMOIR.

J. FRANKLIN LANTRY.

Born January 1, 1859, in St. Catherines, Can., died April 28, 1907. His family moved to Ashtabula, Ohio, when he was a small boy, his father being employed at that time by the L. S. & M. S. Railway. He entered the employ of the West Shore Railway in 1883 as a foreman of carpenters, and by unfailing fidelity to the interests of his employers, coupled with rare good judgment and executive ability, he won his way through various promotions to the position of superintendent of bridges and buildings of the River Division of the West Shore, which position he held at the time of his death.

He became a member of this Association at the Quebec convention in 1903, but had never attended any of its meetings, although he was planning at the time of his death to attend the next convention. On an inspection trip he contracted a severe cold which developed into pneumonia and he was ill but eight days. He is survived by a wife, one son, one daughter, father, mother and two sisters.

Mr. Lantry was one of those men, often found in positions of responsibility, who are loved by all who know them for their great kindness of heart and tender solicitude for those dependent upon them, both in business life and the home circle. In his domestic life he was a most tender and loving husband and father. Had he attended our conventions and become acquainted with our members he would have won for himself a very warm place in our hearts. We sincerely mourn his departure and extend our heartfelt sympathies to the loved ones he left.

MEMOIR.

WALTER GILMAN BERG.

Walter Gilman Berg, the seventh President of this Association, died suddenly at New York, May 12, 1908.

At the time of his death he was president of the American Railway Engineering and Maintenance of Way Association, which association has issued a very elaborate memoir, from which we have copied very extensively.

He was born on January 12, 1858. On his paternal side he was descended from Franc D'Angelo, of a distinguished Italian family, which settled in Germany in the eighteenth century. D'Angelo, who, though in mercantile life devoted much of his time to the gratification of artistic tastes, and, as a contemporary of Goethe, made his home at Frankfort-on-the-Main, the center of an artistic and musical coterie. Mr. Berg's father, Professor Albert W. Berg, was born at Frankfort-on-the-Main, but received his education in France, and though German by name, was essentially French in character. When quite young, after his parents had removed to America, he evinced a decided musical talent, and was sent to Paris to complete his education. On his return he commenced a career as a teacher of music and a composer, which brought to him an artistic reputation of the highest order, ending only at his death in 1906. Professor Berg was married on July 7th, 1853, to Miss Helen McGregor Morse, who was descended from English Puritan ancestry. It is worthy of note that Yale College was founded in the house of her great-great-grandfather, Rev. Samuel Russell, a prominent man of his time. She was born in Hanover, N. H., the seat of Dartmouth College. She inherited an inclination to intellectual work, and her environment assisted in developing it.

Mr. Walter G. Berg thus came naturally by inheritance to intellectual qualities, which permeated his whole life. As a child, at birth, he was very frail, and only by constant care developed a physique which, though slender, permitted great activity, even in his nursery days. Even at that early period there were marked indications of that pertinacity of purpose which actuated his whole life. At a very early age he gave evidence of rare musical ability, and all through manhood, while professional duties kept music in abeyance, his facility of reading at sight and natural aptitude was such that he could perform creditably upon the organ or piano, even though he had not touched the instrument for many months.

During his early studies, his exceeding vivaciousness often led him into trouble, but he always came out ahead, and perseveringly reached the goal.

At nine years of age he was taken to Europe, and began a course of education which lasted thirteen years. The system of recreation in vogue at the schools which he attended appealed to him, and he entered heartily into the various sports. He was wont to take, at first with his tutors, and later alone, long foot tours covering Germany, Austria, Switzerland, Italy and France. His bodily strength was thus developed, and his keen powers of observation added greatly to a high degree of culture. His whole university career was marked by eminence in scholarship, which was crowned by the award of the Gold Medal, offered by the King of Wurtemburg, for a treatise on spherical conic sections. The award of this prize was accompanied by the testimony of the committee that not only the accuracy of folio drawing showed superior skill, but the accompanying thesis evinced unusual acquaintance with mathematical literature. Congratulations were showered upon him, and the Polytechnic Institute at Stuttgart awarded him a scholarship, and tendered him employment on government surveys and other marks of distinction.

Returning to this country, he entered railway service in 1879 as office assistant and shop inspector of railroad bridges of the Delaware Bridge Company, and in 1880 entered the employ of the engineering department of the Richmond & Allegheny Railroad, serving as bridge inspector, engineer of bridges and buildings and engineer in Chicago. In 1882 he entered the service of the East Tennessee, Virginia & Georgia Railroad as principal assistant engineer.

In January, 1883, he entered the service of the Lehigh Valley Railroad Company as assistant engineer, in charge of the design and construction of shop buildings and roundhouses, preliminary surveys, location and construction of branch lines, and in charge of chief engineer's office.

In 1886 Mr. Berg designed and constructed the Lehigh Valley creosoting plant at Perth Amboy, and was given entire charge of the operation of the plant, in addition to his duties as assistant engineer. This plant was among the earliest of the kind to be operated by an American railroad. The plant was abandoned some years later, but Mr. Berg, through his studious habits, became an authority on the creosoting process.

On November 1, 1887, he was appointed principal assistant engineer, with office at Jersey City, for the extension of the Lehigh Valley lines east of South Plainfield and the development of its water-front properties. In this capacity he constructed the double-track road from South Plainfield to the Jersey City terminal, and designed and constructed the first piers now in use at the latter point. This latter work was a sample of his originality in design, especially the pier layout, by means of which a large amount of slip room was procured in the face of limited width of water-front, the piers being placed on an angle.

On December 1, 1898, he was made engineer maintenance of way of the Lehigh Valley Railroad, at South Bethlehem, and a few months later was given charge of both engineering and maintenance of way departments.

On February 1, 1900, he was made chief engineer of the Lehigh Valley Railroad, in charge of construction, which position he held at the time of his death.

As chief enigneer, he designed and constructed the large railway shop system at Sayre, Pa., including a large reservoir system used in connection with the same, in which work several phases of his individuality and constructive ingenuity are evident; he also made elaborate studies for elimination of grade crossings through the various cities; made exhaustive studies for present and future harbor improvements at Buffalo and New York, involving the solution of difficult problems, made studies and designs for large terminal yards, not only covering the present needs of actual service, but looking toward the future, which plans are now being followed in actual construction.

The achievements and brilliancy of Mr. Berg's career in the engineering profession conformed with the record he made while a student at college, where his adaptability, studious habits and exceptional intellect were evidenced by his having proof-read German publications, instructed in mathematics, and by his high scholarship.

Mr. Berg had the unusual combination of executive ability and breadth of view with faculty of closest attention to details, working out with his subordinates the minutest detail of any design. He also possessed a wonderfully analytical mind, and always analyzed a subject exhaustively before reaching a conclusion or reporting on the same.

By reason of his remarkable industry, analytical mind and engineering ability, he was frequently engaged with one matter or another outside of his regular vocation and was often called upon by other companies and individuals to pass upon plans and give advice and otherwise act in a consulting capacity.

One of his novel achievements as a consulting engineer was the construction of the freight yard of the Harlem Transfer Company its prosperity. For many years he personally assisted in the editing of the Proceedings, and much of their great value as books of reference is due to his painstaking care and good judgment.

Not only was he an indefatigable worker in the interests of the Association as a whole, but he had a deep personal interest in its members. Especially was this true in case of the younger men who were struggling to fit themselves for better service. To all such he ever extended a ready hand of sympathy and encouragement, and so kindly was this help given that the recipient of it learned to love him as a brother. He was entirely devoid of any feeling or. manifestation of superiority toward anyone in a more humble position in life, and seemed never so happy as when he was extending a helping hand to others. The writer himself, having received great aid and encouragement from this great-hearted man, can speak only in the highest terms of praise of him; and can but feel a personal sense of loss at his early death.

Truly it can be said of him, as of a noted man before him, that the Creator made no mistake when he made Walter G. Berg, for throughout his busy, useful life he was a splendid exemplification of the Golden Rule.

In 1893 Mr. Berg was married to Miss Ruby Burke, of Jennings, Va. Mrs. Berg died in November, 1904. Two children survive them, Walter G., Jr., ten years old, and Moncure B., three and a half years old. He is also survived by his mother, sister and two brothers. One of his brothers, Louis D'Coppet Berg, is a well-known architect of New York City, the other, Alfred Ellery Berg, is a writer and dramatic critic. His sister, Lillie D'Angelo Berg, is a teacher in one of the musical conservatories.

Mr. Berg's funeral was held at St. Paul's Episcopal Church, New York City, on May 14. In respect of his memory, the Lehigh Valley offices were closed, and the very large attendance of its officers and his associates was an expression of the sense of loss sustained by those with whom he had been associated for a quarter of a century. To them his departure meant much more than the mere loss of an official of a corporation. He was to them both a friend and a mentor, and as a superior officer in his department won admiration for acknowledged supremacy in his profession, and obtained the entire confidence of his office staff and subordinates by courtesy and fairness, and by his kindly interest in the welfare of the individual.

The railway which he served with such fidelity for so many years, the various associations, scientific and social, to which he gave so much of the best that was in him, and his friends in every walk in life, will forever cherish his memory.

Mr. Berg in addition to being a member and Past President of the Association of Railway Superintendents of Bridges and Buildings was a member of the American Railway Engineering and Maintenance of Way Association, member of American Society of Civil Engineers, member of the American Roadmasters and Eastern Maintenance of Way Associations, member of the Railway Superintendents Association, member of the Society for the Promotion of Engineering Education, member of the New York Railroad Club, member of the Founders and Patriots of America and member of Holland Lodge, F. and A. M.

The report was received and ordered printed in the Proceedings.

President.—Next in order will be the appointing of the various committees, as follows: Auditing Committee—C. A. Lichty, M. Riney, A. E. Killam; Committee on Resolutions—J. H. Cummin, W. Beahan, C. A. Lichty; Obituary Committee—J. N. Penwell, J. S. Lemond, D. L. McKee. These committees are requested to get in their reports as soon as practicable.

President.—In a general way, I would say that I suppose that most of the members are anxious to see what they can of the city and for that reason we want to condense our meetings just as much as we can and keep them moving along as rapidly as possible; without, however, cutting down the business of the meeting or interfering with getting full and complete reports and full discussion, but avoiding extraneous discussion. The photographer for the National Press Association has arranged to take a group picture of the ladies and members of the Association on the west steps of the Treasury Building on our return from reception by President Roosevelt, about 3 p. m. Thursday afternoon. On account of the steamer trip to Mt. Vernon tomorrow afternoon it will be necessary to omit the afternoon session, and in order to take care of the business properly I want to extend the morning session to 1.30 p. m.

Mr. A. S. Markley.—I move that we adjourn until 2 o'clock this afternoon.

Motion was duly seconded and carried and adjournment taken until afternoon session.

AFTERNOON SESSION.

Tuesday, October 20, 1908.

President.—The first order of business this afternoon is the reading of reports of Committees on Subjects for Reports and Investigations. As all the members have printed advance copies of most of the reports, I think we can well dispense with their reading and thus save the time of the meeting.

Additional reports were then handed in and read as follows: New subject, number seven, "Re-enforced Concrete Culverts and Short Span Bridges"; standing subject number two, "Fire Protection." (See reports.)

President.—We have no reports on the following: New subject, number three, "Protection of Structures Against Effects of Electric Currents"; standing subject number three, "Fences, Road Crossings and Cattle Guards"; standing subject number six, "Coaling Stations and Cinder Pits."

President.—Next in order is unfinished business. As there appears to be nothing in that line the next in order is new business. Under that head I presume we might as well now hear the report of the committee appointed to revise our Constitution and By-Laws. All the members have printed copies of this committee's report.

REPORT OF COMMITTEE APPOINTED TO REVISE THE CONSTITUTION AND BY-LAWS.

To the Officers and Members of the Association of Railway Superintendents of Bridges and Buildings:

The committee on this subject has spent considerable time on it. We do not know, of course, how it is going to suit the members. It is presumed that most of you have read the printed report giving the proposed new Constitution and By-laws, and you will, I hope, be ready to take them up article by article and pass upon them. I am free to say as chairman of this committee that we will be glad to hear of any criticisms and to answer any questions that may be raised. We have given it considerable thought, and we ought to be able to say why we have made any changes that appear.

C. A. Lichty,
A. Montzheimer,
A. S. Markley,
Committee.

The report was then read and passed upon, article by article, amendments being offered and adopted, changing certain articles from the form given in the committee's report to read as follows:

Article III. Section 3. Any member elected a life member of this Association shall have all of the privileges of an active member, but shall not be required to pay annual dues. To be elected a life member he must have been a member of this Association at least five years, and before being elected must have been pensioned by the railway company for which he works, or have retired from active railway service.

Article VI. Section 2. The President and Treasurer shall be elected by ballot by a majority of votes cast, and shall hold office for one year, or until successors are elected. No member in arrears shall be eligible for office, and the President shall not be eligible for re-election.

Article VII. Section 1. At the first session of the annual meeting the President shall appoint a committee of three members, not officers of the Association, who shall send names of nominees for officers of the Association for the ensuing year to the Secretary, before the election of officers is in order, and the names shall be announced as soon as received. The assignment shall be such that at least two members shall have served during the previous year. The election shall not be held until the day after announcement, except by unanimous consent. Nothing in this section shall be construed to prevent any members from making nominations.

(See revised Constitution and By-Laws in latter part of Proceedings.)

Mr. Montzheimer.—I would recommend that the entire Constitution and By-Laws as read and amended be adopted by the Association.

Motion was duly seconded and carried.

Mr. A. S. Markley.—The question arises in my mind as to when this new Constitution takes effect.

President.—Ordinarily, unless otherwise specified, an act or amendment takes effect from the time of its adoption.

Mr. Sheldon.—It seems to me that this is covered by Roberts' Rules of Order, which the Constitution states shall govern the Association in its discussions and which, I believe, provides that when a motion is adopted it takes effect at once unless otherwise provided.

There followed an informal discussion on the question of new badges.

Mr. A. S. Markley.—I move that the Executive Committee be authorized to select a design for new badges, both for the members and the ladies, and also one for visitors, if thought best, and provide same for the next annual meeting.

Motion was duly seconded and carried.

Life membership in the Association was then voted to the following: O. J. Travis, Henry W. Phillips, L. H. Porter.

A letter was then read by the Assistant Secretary from Mr. F. H. Kropp, assistant to the auditor of the S. P., L. A. & S. L. Road, on the subject of "Methods of Accounting." No action was taken.

President.—Next in order is discussion of last year's reports. The first was "Experience in Concrete Bridges, Arches and Subways." There was no report made last year. (No discussion.)

President.—The second was "Concrete Building Construction." (No discussion.)

President.—Number three is "Experience as to Expansion and Contraction of Concrete Walls, Either Reinforced or Plain Concrete." (See discussion on last year's report.)

President.—The next subject is subject number four. "Action of Sea Water on Concrete." (See discussion on last year's report.)

President.—We will now have to interrupt the discussion of last year's reports, as I have arranged with Mr. Ernest F. Hartmann, president of the Carbolineum Wood Preserving Company of New York City, to give us an illustrated talk on the subject "Wood Preservation by the Open Tank Process."

Mr. Hartmann then gave a lengthy and able talk on the subject, illustrated with many charts and photographs, report of which is given in another part of the Proceedings. (See index.)

President.—I am sure that we all greatly appreciate the interesting talk given us by Mr. Hartmann, for it has given our members many new ideas. As the time is quite late we will stand adjourned until nine o'clock tomorrow (Wednesday) morning.

MORNING SESSION.

WEDNESDAY, October 21, 1908.

President.—The first order of business will be the continuation of the discussion on last year's reports. The next is number five, "Recent Experience in the Use of Wooden and Asbestos Smoke Jacks for Engine Houses." (No discussion.)

President.—Next is number six, "Combination Fastening and Lock for Rolling and Sliding Doors on Freight Houses and Other Buildings." (No discussion.)

President.—Next is number seven, "Construction of Towers and Guides for Lights on Draw Bridges." (No discussion.)

President.—Next is number eight, "Recent Experience in Protecting Steel Railroad Bridges Against the Action of Salt Brine from Refrigerator Cars." (No discussion.)

President.—Next is last year's standing subject number one, "Pile and Frame Trestle Bridges." (No discussion.)

President.—Next is last year's standing subject number two, "Water Supply." (No discussion.)

President.—Next is last year's standing subject number three, "Fire Protection," which was carried over as new subject for this year, and which will be brought up later. (No discussion.)

President.—Next is last year's standing subject number four, "Fences, Road Crossings and Cattle Guards." (No discussion.)

President.—Next is last year's standing subject number five, "Preservatives for Wood and Metal." (No discussion.)

President.—That finishes the reports from last year's committees. We will now proceed to new business. If there is nothing else under that subject the next in order will be the reports of this year's committees. The first subject is "Water Proofing of Concrete Covered Steel Floors." You all have the report which has been printed and sent out on this subject. Does anyone care to raise any question on this? If there are no remarks or discussions on this we will take up number two, "Modern Equipment and Tools for Erection of Steel Bridges." Are there any members of committee on number two present? Is there any discussion on the report which you have in printed form? If there is no discussion on number two we will take up number three, "Protection of Structures Against Effects of Electric Currents."

President.—There has been no report made by this committee. Mr. Richey, the chairman, told me the other evening that they had not yet succeeded in getting enough information together for a report, and it is rather a difficult subject. The next is number four, "Protection of Embankments from the Effects of High Water by Riprap or Otherwise." Has anyone any questions on this? If there are no remarks or discussion we will pass to number five, "Experience in the Use of Gasoline Engines and Kerosene Engines or Combination of Same for Water Supply, Drawbridges, etc." (See discussion on subject number five.)

President.—The next subject is number six, "Modern Dwelling Houses for Section Foremen and Section Men in Outlying Districts." (See discussion on subject number six.)

President.—The next subject is number seven, "Re-enforced Concrete Culverts and Short Span Bridges." (See discussion on subject number seven.)

President.—The next subject is number eight, "Methods of Erecting Truss Bridges: (a) Maintaining Traffic; (b) No Traffic." (See discussion on subject number eight.)

President.—We will hear next the reports of the Auditing and other committees appointed yesterday.

REPORT OF AUDITING COMMITTEE.

WASHINGTON, D. C., October 21, 1908.

To the Officers and Members of the Association of Railway Superintendents of Bridges and Buildings:

Your committee has audited the accounts of the Secretary and Treasurer and has found them correct, as shown in their reports.

M. RINEY,
A. E. KILLAM,
C. A. LICHTY,
Committee.

Mr. Canty.—I move that the reports be accepted and printed in the Proceedings.

Motion was duly seconded and carried.

President.—Next we will hear from the Nominating Committee.

REPORT OF THE NOMINATING COMMITTEE.

WASHINGTON, D. C., October 21, 1908.

To the Officers and Members of the Association of Railway Superintendents of Bridges and Buildings:

The Nominating Committee presents the following names for officers and members of Executive Committee for 1908–'09:

President—J. P. Canty, Boston & Maine R. R.
First Vice-President—H. Rettinghouse, C. & N. W. Ry.
Second Vice-President—F. E. Schall, L. V. R. R.
Third Vice-President—J. S. Lemond, Southern Ry.
Fourth Vice-President—A. E. Killam, Intercolonial Ry.
Secretary—S. F. Patterson, Boston & Maine R. R.
Treasurer—C. P. Austin, Boston & Maine R. R.
Executive Committee—J. N. Penwell, Lake Erie & Western Ry.; Willard Beahan, L. S. & M. S. Ry.; F. B. Scheetz, Mo. Pac. Ry.; W. H. Finley, C. & N. W. Ry.; T. L. D. Hadwen, C. M. & St. P. Ry.; T. J. Fullem, Ill. Central R. R.

(Signed) C. A. LICHTY,
G. W. ANDREWS,
J. H. MARKLEY,
J. B. SHELDON,
Committee.

Mr. A. S. Markley.—I move the adoption of the committee's report.

Motion was duly seconded and carried.

President.—The next is the report of the Committee on Selection of Subjects.

REPORT OF COMMITTEE ON SELECTION OF SUBJECTS.

WASHINGTON, D. C., October 21, 1908.

To the Officers and Members of the American Railway Bridge and Building Association:

Your Committee on the Selection of Subjects for next year's work presents the following report:

Number one. Various methods of carrying electric transmission wires over railway tracks and best way to protect tracks and company wires.

Number two. Inspection of bridges and buildings; blanks to be used; method of inspection, frequency, etc.

Number three. Best organization for bridge and building department.

Number four. Water stations and water supply.

Number five. Turntables; design, length and power for operating them.

Number six. Design of material, yards, platforms and sheds.

Number seven. Design of portable derrick and push car for same.

Number eight. Best methods for housing railway bridge and construction gangs.

Number nine. Pile and frame trestle bridges.

Number ten. Docks and wharves, including appliances for transferring cars from wharves to floating equipment. Best method of wheeling freight from dock houses to boats at various stages of water.

Number eleven. Railway engine house construction.

Number twelve. Painting. Best paints to use; effect of salt water; use of compressed air in painting and cleaning iron.

Number thirteen. Coaling stations and cinder pits.

ARTHUR MONTZHEIMER,
J. P. SNOW,
G. F. SWAIN,
W. H. FINLEY,
J. L. NEFF,
Committee.

Following an informal discussion of the merits of the subjects selected it was on motion by Mr. Sheldon, duly seconded and carried, decided to place the committee's report on the table, and take same up at the next session for further discussion.

President.—Gentlemen, it is growing late and we must take the cars at 2 for our trip to Mt. Vernon.

Mr. A. S. Markley.—I move that we adjourn until eight o'clock this (Wednesday) evening.

Motion was duly seconded and carried.

Adjournment was then taken until evening session.

EVENING SESSION.

WEDNESDAY, October 21, 1908.

President.—The meeting will please come to order. The next subject is nine, "Smoke Jacks for Engine Houses." Will the members of this committee who are present come to the front? The report has been printed. Is there any discussion on this? It is quite an important subject and becoming more so every year. If there is no discussion on number nine we will pass to the next subject, which is standing subject number one, "Pile and Frame Trestle Bridges." As it appears that no discussion is now desired on this, we will pass to the next, which is number two, "Fire Protection." (See discussion on subject number two.)

President.—The next subject is number three, "Fences, Road Crossings and Cattle Guards." (No discussion.)

President.—The next subject is number four, "Construction of Coffer Dams." (See discussion on subject number four.)

President.—The next subject is number five, "Preservation of Timber." (See discussion on subject number five.)

President.—The next subject is number six, "Coaling Stations and Cinder Pits." (No discussion.)

President.—This finishes the regular list of subjects for report and discussion for this year. Does any member wish to discuss further any of the subjects which were up this morning?

Mr. Steffens.—I would like to bring up subject number three, "Fences, Road Crossings and Cattle Guards." (See discussion of subject number three.)

President.—If there is no further discussion on this subject, is there any on other subjects? Taking them up again in their order, they are:

Number one, "Water Proofing of Concrete Covered Floors." (No discussion.)

Number two, "Modern Equipment and Tools for Erection of Steel Bridges." (See discussion of subject number two.)

Number three, "Protection of Structures against Effects of Electric Currents." (No discussion.)

Number four, "Protection of Embankments from the Effects of High Water by Riprap or Otherwise." (See discussion on subject number four.)

Number five, "Experience in the Use of Gasoline Engines and Kerosene Engines, or Combination of Same for Water Supply, Drawbridges, etc."

President.—We had some discussion on that this morning. Is any further discussion desired? If not, we will take up the next question, number six, "Modern Dwelling Houses for Section Foremen and Section Men in Outlying Districts."

President.—We had a very full discussion on that this morning. Is there any further discussion on number six? If not, we will pass to subject number seven, "Reinforced Concrete Culverts and Short Span Bridges."

President.—We had a very thorough report and discussion on that this morning. Any further discussion or remarks? This is an important question which is coming more and more to the front. If there is no further discussion, we will take up number eight, "Methods of Erecting Truss Bridges: (a) Maintaining Traffic; (b) No Traffic." (See discussion on subject number eight.)

President.—The next subject in order is number nine, "Smoke Jacks for Engine Houses." (See discussion on subject number nine.)

President.—The next in order is standing subject number one, "Pile and Frame Trestle Bridges."

President.—You have a printed report on this. Is there any discussion? As it appears not, this brings us to standing subject number two, "Fire Protection," on which we already have had a discussion this evening. I believe all other reports have now been up before us at this session.

Mr. Montzheimer.—I have the report of the Obituary Committee ready, if the members care to take this up now.

REPORT OF OBITUARY COMMITTEE.

WASHINGTON, D. C., October 21, 1908.

To the Officers and Members of the Association of Railway Superintendents of Bridges and Buildings:

WHEREAS, During the last year it has pleased God in His Allwise Providence to remove three of our respected members from this Association by death, thus reminding us of the uncertainty of life, the certainty of death and the very great importance of right living and the preparation for death, therefore be it

Resolved, That we deeply and sincerely mourn the loss of these Brothers, Walter G. Berg, Edward F. Reynolds and J. Franklin Lantry.

Resolved, That our heartfelt sympathy be extended to the widows and families of our deceased Brothers by the Secretary and that a copy of these resolutions be printed in our Proceedings and a copy sent to their respective families.

J. N. PENWELL,
J. S. LEMOND,
D. L. MCKEE.

President.—If there are no objections the report will stand adopted as read. It is so adopted.

President.—Have any of the members anything to bring up in the way of new business?

Mr. Steffens.—I would like to inquire whether the Committee on Subjects have made a report.

President.—They have made a report, which was laid on the table for further consideration. The report is still on the table and the committee is ready for any suggestions on subjects. The report will probably be taken from the table tomorrow morning and acted on.

Mr. A. S. Markley.—I move that we adjourn until ten o'clock tomorrow (Thursday) morning.

Motion was duly seconded and carried and adjournment taken until Thursday morning session.

MORNING SESSION.

THURSDAY, October 22, 1908.

President.—The report of the Committee on Selection of Subjects was laid on the table for further consideration yesterday, and if the members desire it is now in order to take action on this matter.

Mr. Sheldon.—I move that the report of the Committee on Subjects be taken from the table for consideration.

Motion was duly seconded and carried.

Report of the Committee on Selection of Subjects was then read by Mr. Montzheimer.

President.—In connection with the committee's report you will note that they have followed the usual method of having some special subjects and some standing subjects. So far as I am able to see there is no very good reason for having these two classifications. Some of the standing subjects are just as important as the special subjects, and it has occurred to some of our members that there should be no distinction in their classification.

Mr. Perry.—I move that all the subjects be included under one heading and that classification as between special and standing subjects be done away with.

After some informal discussion motion was duly seconded and carried and the committee instructed to revise their report accordingly, which was done and the report was again read as revised.

On motion duly seconded the report of the Committee on Subjects was then received and approved as revised.

President.—Is there any further business?

Mr. Montzheimer.—The Committee on Resolutions is now ready to report.

REPORT OF COMMITTEE ON RESOLUTIONS.

WASHINGTON, D. C., October 22, 1908.

To the Officers and Members of the Association of Railway Superintendents of Bridges and Buildings:

Your Committee on Resolutions respectfully submit the following report:

Resolved, That the thanks of this Association be extended to the railroad, Pullman and other companies, individually and collectively, for their many courtesies tendered us in connection with our 18th Annual Convention.

To President Macfarlane of the Board of Commissioners of the District of Columbia, and Mr. Walter J. Douglas, Engineer of Bridges of the District, for their very able and interesting addresses.

To the management of the Arlington Hotel for their uniform and cordial treatment of our members and their families.

To the daily press for their interest in our work.

To Mr. W. M. Camp, editor of the *Railway Review*, for his intense interest, not only at this, but at our previous meetings.

To the Supply Men's Association and the different supply houses which made exhibits at the Convention, and assisted in such a generous and free-hearted manner in providing for the entertainment of the members and their families.

To the Washington Terminal Company for the very interesting and instructing trip around their terminal.

J. H. CUMMIN,
W. BEAHAN,
C. A. LICHTY,
Committee.

Mr. A. S. Markley.—I move that the report of the committee be received and printed in our Proceedings.

Motion was duly seconded and carried.

President.—The next in order of business I presume will be the selection of place for the next convention.

Mr. Cahill.—I nominate Jacksonville, Fla.

Mr. Lemond.—I nominate New Orleans, La.

Secretary Patterson.—I nominate Cleveland, Ohio. I may say in this connection that I have received letters of invitation from Atlantic City, Chicago, Detroit, Toledo, Buffalo and Niagara Falls.

President.—The result of the first ballot is as follows: Jacksonville, 54; New Orleans 13, and Cleveland 3. By your vote you have chosen Jacksonville, Fla., as the place for your next meeting.

Mr. Lemond.—I move that the Executive Committee be authorized to change the meeting place to Miami or some other point in Florida if it is found that suitable accommodations cannot be had at Jacksonville at reasonable prices.

Motion was duly seconded and carried.

President.—We will now consider the nominations for officers, which are as follows:

President, J. P. Canty; first vice-president, H. Rettinghouse; second vice-president, F. E. Schall; third vice-president, J. S. Lemond; fourth vice-president, A. E. Killam; secretary, S. F. Patterson; treasurer, C. P. Austin; members of executive committee, J. N. Penwell, W. Beahan, F. B. Sheetz, W. H. Finlay, T. Hadwen, T. J. Fullem.

President.—Has anyone any other nominations to offer? If there are no other nominations, a motion that the nominations be closed is in order.

Mr. A. S. Markley.—I move that the nominations be closed.

Motion duly seconded and carried.

Mr. C. M. Large.—In order to save time I would move that the Secretary be instructed to cast one ballot for the persons named.

Mr. A. S. Markley.—I second the motion.

President.—Are there any objections on the part of any member to this method of procedure? If not, will those in favor of the motion as made and seconded signify it in the usual manner? Carried.

Secretary.—I hereby cast that ballot.

President.—The officers as nominated have been unanimously elected.

The President then called on the officers-elect and requested each to assume the office to which he was elected. All those present accepted.

Mr. Canty.—It is to be presumed that we all desire to finish up the business of this convention without delay, therefore I will not bore you at this time with any long-winded talk. My desire is to impress on you that I am very much pleased to serve as your President during the coming year and, furthermore, it should be distinctly understood that I feel honored by the position. It will be my aim to carry along all the affairs of this Association usually handled by the President in a manner similar to what has been done by my predecessors.

Of course, as you are well aware, to have a successful year your assistance is needed. Each of us undoubtedly feels that the time given to our regular railroad duties is about all that we can afford to put in on work. I do not hesitate to state that every member of this organization probably uses more energy in his regular railroad work, and effective energy at that, than would be required in other similar industrial callings. However, notwithstanding that we are all decidedly busy men and, as one may say, loaded up to the limit, we can by a little extra exertion give a fair amount of time and energy to furthering the ends of this Association. It will be in no sense wasted effort. Active work in this organization is strongly educative in its results. Not one of us who participate in the discussions at the conventions and do our part in making up reports during the remainder of the year but what gains considerably personally. This training not only gives us more personal power, but it also results indirectly in the increased efficiency of every man working under our supervision, thereby doing a great good for the railroads which employ us. Consequently, I feel that all of you will continue to give your support to this Association and help me to carry out the work of keeping our organization up to its past reputation.

I thank you, gentlemen, for the honor which you have conferred on me. (Applause.)

Mr. A. S. Markley.—I will move that we adjourn to meet in Jacksonville, Fla., the third Tuesday in October, 1909.

Motion was duly seconded and carried and adjournment taken.

S. F. Patterson

Secretary.

DISCUSSION OF COMMITTEE REPORTS FOR 1907-1908.

CONTINUED FROM THE SEVENTEENTH ANNUAL CONVENTION.

Subjects number one and two as follows:

I. Experience in Concrete Bridges, Arches and Subways;

II. Concrete Building Construction;
were passed without discussion.

III.

EXPERIENCE AS TO EXPANSION AND CONTRACTION OF CONCRETE WALLS, EITHER REINFORCED OR PLAIN CONCRETE.

Mr. A. S. Markley.—In the report on this subject last year I gave as our experience a certain concrete curb which was reinforced, and in which cracks appeared. It is still in the same condition, and my opinion, therefore, is that reinforcement bars do not entirely take care of expansion, and that it is necessary to make provision for it.

Mr. J. H. Markley.—For example, we have a breakwater 700 feet long in which there are no expansion joints and no reinforcement, and it has shown no cracks, and stands all right.

Mr. Alexander.—We have used a great deal of concrete in the last six or seven years. The first year or two we built largely without reinforcing and made it somewhat heavier than where reinforcing was used, and I find the work has stood well. We are using reinforcing largely now in culverts and ash pits, of old rails and corrugated steel bars. Where we have little room for culvert covers under ballast, we use old rail covers encased in concrete to preserve the rails.

Mr. A. S. Markley.—Mr. Alexander's proposition is an entirely different one. The committee's report is regarding a wall anchored at both ends, built in place, 300 to 400 feet in length, and in such a case you should provide for expansion. It is conceded by all interested, not in curbing alone, but in all classes of concrete work, that where reinforcement is used it is an advantage and will distribute the expansion throughout the length of the wall or curb. While reinforcement does not eliminate the expansion entirely, it distributes the cracks so that they are more frequent and none of them wide enough to be noticed at a distance.

Mr. J. H. Markley.—In our city they build mile after mile of concrete curbs, and do not reinforce it and have no bad results. I think the reinforced proposition is in many cases a fad. These curbs are built in place with partial joints, but not extending all the way through.

Mr. Killam.—On the Intercolonial Railway we have been doing a good deal of concrete work on platforms and buildings. We have put up some machine shops that are all built of concrete, the foundation walls of which are not reinforced (some sections of them have joints made for expansion). Our roundhouses are built with concrete foundations with no expansion joints. I have examined them lately and while one may see the slightest sign of a crack, these defects are much less conspicuous than an expansion joint. We do not put reinforcement into platforms, but divide them into sections of five feet and after they have hardened to a certain consistency, put the top on. The only cracking is where the frost gets under them and raises the ground. There is one platform which will bear out what Mr. J. H. Markley has said. It is 1,000-feet long and 7-feet wide. It was built by excavating earth and putting down seven inches of cinders in its place. On top of that was laid four inches of cinder concrete, then an asphalt mastic and the job was finished off with a little cement. That was put down a year ago and there is not a crack in it that you can put a pen-knife blade into. The frost has no effect. We have some quite heavy concrete walls from 16 to 17 feet high, and, in these, expansion joints are put in every 50 feet. Walls have been in a year and there are no cracks. The foundations for our scales and engine house pits are not reinforced, yet they show no cracks. The walls of our buildings, however, are all reinforced with twisted metal, and are standing well. We consider that reinforcement should be governed by circumstances and that no one principle covers the whole thing.

Mr. King.—We have done considerable platform and sidewalk work, and have provided for expansion by joints, so that if a break occurs it is at the joints and does not make an unsightly appearance.

Mr. Killam.—We have some platforms put down in blocks, but in some few cases I have seen cracks where there were no joints. That is on account of the frost getting underneath. In the thousand-foot walk I referred to that is provided for and there are no cracks.

Mr. A. S. Markley.—How much did that walk cost?

Mr. Killam.—Two dollars and fifty cents per square yard.

Mr. A. S. Markley.—Evidently the hard times didn't hit your road.

President.—If there is nothing more on the subject we will pass to the next.

IV.

ACTION OF SEA WATER ON CONCRETE: (A) CONCRETE MADE IN AIR AND SUNK INTO SEA WATER; (B) CONCRETE DEPOSITED DIRECT INTO SEA WATER.

Mr. Higgins.—With last year's report on this subject there were shown in the Proceedings some photographs of piers at the Charlestown Navy Yard. The surface of that concrete looks very badly at present. There are two or three places where the sea water itself has done no harm, but the mechanical action of the ice has had a very bad effect.

Mr. Aldrich.—In connection with that report, I made the statement a year ago regarding the pier in question that it had not deteriorated under the action of salt water. I wish now to withdraw it. Being on the ground a year ago and the old form that had been there having just been taken out, it did not appear to show any ill effects.

Mr. Higgins.—In the Panama district the French who worked there 25 or 30 years ago put in some masonry retaining walls where the sea could get at it. They were built of a kind of freestone. Although there is no frost there, the stone has disintegrated and left the cement mortar sticking out, which is quite an instance of where the stone has disappeared, leaving the cement still in good condition. This is also shown in a breakwater which was built some twenty years ago, and in a great many cases the numbers on the blocks can still be seen, and at a place where the sea has been washing on them all the time for nearly twenty years.

Mr. Killam.—I stated a year ago, and will reaffirm it now, that there is not a piece of concrete work around the foundations of our bridges located over tidewater, where the masonry was poor and we put concrete around it, which is not more or less damaged. On my examination last year it was beginning to be affected, and this summer in some places I found about half a foot of concrete mud around the bottom, the rest being all gone. It is the same in all cases where concrete is used in places where the tide rises and falls. Above the high-water mark the concrete is as good as new. I would like to see a piece of concrete work that has been in eight or ten years, where the tide rises and falls, which is not disintegrated.

Mr. Sheldon.—The New York, New Haven & Hartford Railroad has some piers in the Warren River (an arm of Narragansett Bay), where the tidewater current is very swift. These piers were built in 1855, of rough ledge stone without mortar joints. About twenty-five years ago a cofferdam of sheeting was placed around them, with a space between sheeting and pier, varying from three to five feet. This space was filled with concrete and the sheeting left in place until it rotted away. It remained intact for fifteen years or more; but was entirely gone in twenty years. For a year or two after sheeting was gone, there appeared to be little change in face of concrete, but after this, the effects of floating ice could be seen, until about one year ago there were indentures eight inches or more in depth.

During the past year the effect has been very marked, there being holes two feet deep, and concrete plainly shows signs of deterioration, being soft in places and having little cohesion.

The same effects were noted on the cement mortar joints of piers in tidewater at Mystic, Conn.

The bad condition of concrete is noticed principally in that part which is alternately submerged and exposed to the air.

Subjects numbers five, six, seven and eight as follows:

V.—Recent Experience in the Use of Wooden and Asbestos Smoke Jacks for Engine Houses;

VI.—Combination Fastenings and Locks for Rolling and Sliding Doors on Freight Houses and other Buildings;

VII.—Construction of Towers and Guides for Lights on Draw Bridges;

VIII.—Recent Experience in Protecting Steel Railroad Bridges against the Action of Salt Brine from Refrigerator Cars;

passed without discussion.

COMMITTEE REPORTS

FOR 1908 AND 1909.

PRESENTED AT THE EIGHTEENTH ANNUAL
CONVENTION, WASHINGTON, D. C.,
OCTOBER, 1908.

I.

WATERPROOFING OF CONCRETE COVERED STEEL FLOORS OF BRIDGES.

REPORT OF COMMITTEE.

CHICAGO, August 5, 1908.

To the Association of Railway Superintendents of Bridges and Buildings:

Your committee on subject number one, "Waterproofing of Concrete Covered Steel Floors of Bridges," begs leave to submit the following reports made by members of the Association in response to inquiries sent out early in the year.

These reports indicate that in all waterproofing either some asphalt or tar is used, the tendency being more and more in the line of pure asphaltic compounds. In the majority of cases at the present time either a felt or a fabric such as burlap is used, which is thoroughly saturated and bonded together with an asphaltic preparation, being generally applied when hot by the use of brushes or mops. In other cases the asphalt is used in a mastic form without any felt covering or fabric being introduced. This matter is still in an experimental stage with most of the railways. Considerable work is being done along this line, as indicated by the letters attached, but sufficient time has hardly elapsed to fully determine the value of the different kinds of waterproofing with regard to durability and effectiveness. There is attached to this report a new set of specifications and instructions for waterproofing metal and masonry structures as prepared by Mr. W. H. Finley, Assistant Chief Engineer, Chicago & North Western Railway Company. This specification supersedes an earlier specification of Mr. Finley's embodied in a paper read by him before the Cement Users' Association, which specification has been generally adopted.

This committee is not prepared to recommend any particular kind of waterproofing. The various methods in use by various roads, as shown in reports attached hereto, would indicate that all of these have some merit and each particular condition calls for some slightly different treatment and no one method can be said to be the best for all cases.

Committee
A. F. MILLER, *Chairman.*
AUSTIN LORD BOWMAN.
A. A. PAGE.
I. F. STERN.

CIRCULAR OF INQUIRY.

The Committee on subject number one for a report to the next annual meeting to be held at Washington D. C., October next, would like to get information on the different classes and methods used in waterproofing steel concrete covered solid floor bridges, and hope we will have your hearty coöperation and an early reply to the following questions with prints or sketches if you can conveniently do so.

A. In your solid floor construction do you use I-beam or trough system of floor?

B. Do you use a girder span? If so, how do you prevent water following line of girder and gussets where the adhesion of concrete and iron is imperfect?

C. If trough floor system is used and supported by horizontal beam and columns, do you have any trouble on account of the expansion and contraction of metal cracking the concrete or waterproofing in this kind of construction?

D. Do you use a mastic or an asphalt cover over concrete; if so, how is it applied and what results do you get?

E. Do you use a felt covering over concrete; if so, how many layers, and how is it applied?

F. Do you protect your waterproofing from stone ballast or gravel; if so, what method is used to prevent a puncture?

G. If you have any other methods than those outlined above which are impervious to water, we will be thankful for any other information you may have on this subject.

EXTRACTS FROM LETTERS RECEIVED IN ANSWER TO LETTER OF INQUIRY.

W. H. Moore, New York, New Haven and Hartford Railroad:

I am sending you blue prints showing the methods which have been employed within the last year for waterproofing solid floor bridges on the Harlem River Branch, but I may say that this work has not been in service long enough for us to form much of an opinion as to the efficiency of the systems used.

The drawings contain the general specifications for doing the work.

I think it is come to be very generally recognized that in order to be effective, the waterproofing material must have a good smooth surface to rest on without any sharp corners or angles and that the waterproofing layer must in its turn be covered by a protective coating which will prevent it from injury when the track is being tamped or otherwise, and also protect it from the direct action of the sun.

Taking the committee's questions in order, I will reply as follows:

A. In our solid floor construction, we have hitherto principally used the trough system of floor, but in certain instances have used I-beams. We are now using on some of our through and deck plate girder bridges, reinforced concrete floors.

B. In the girder spans the waterproofing is carried up the side of the girder a short distance above track level and in some cases

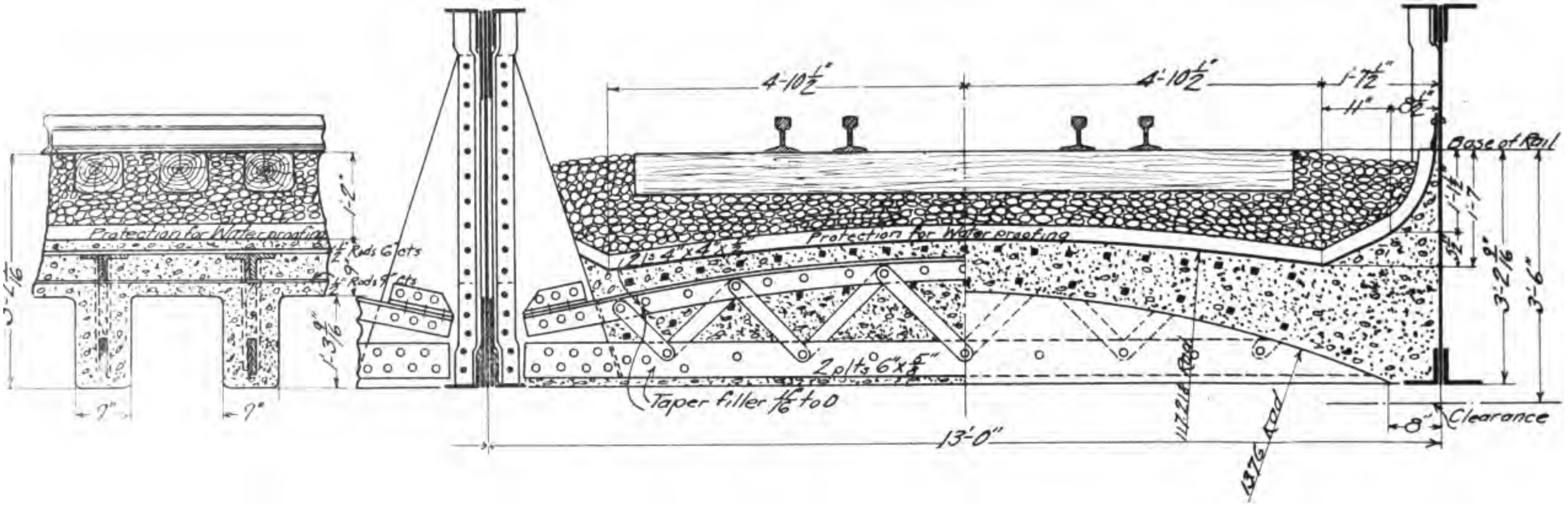


FIG. 1.—Waterproofing of Bridge Floors. New York, New Haven & Hartford R. R.

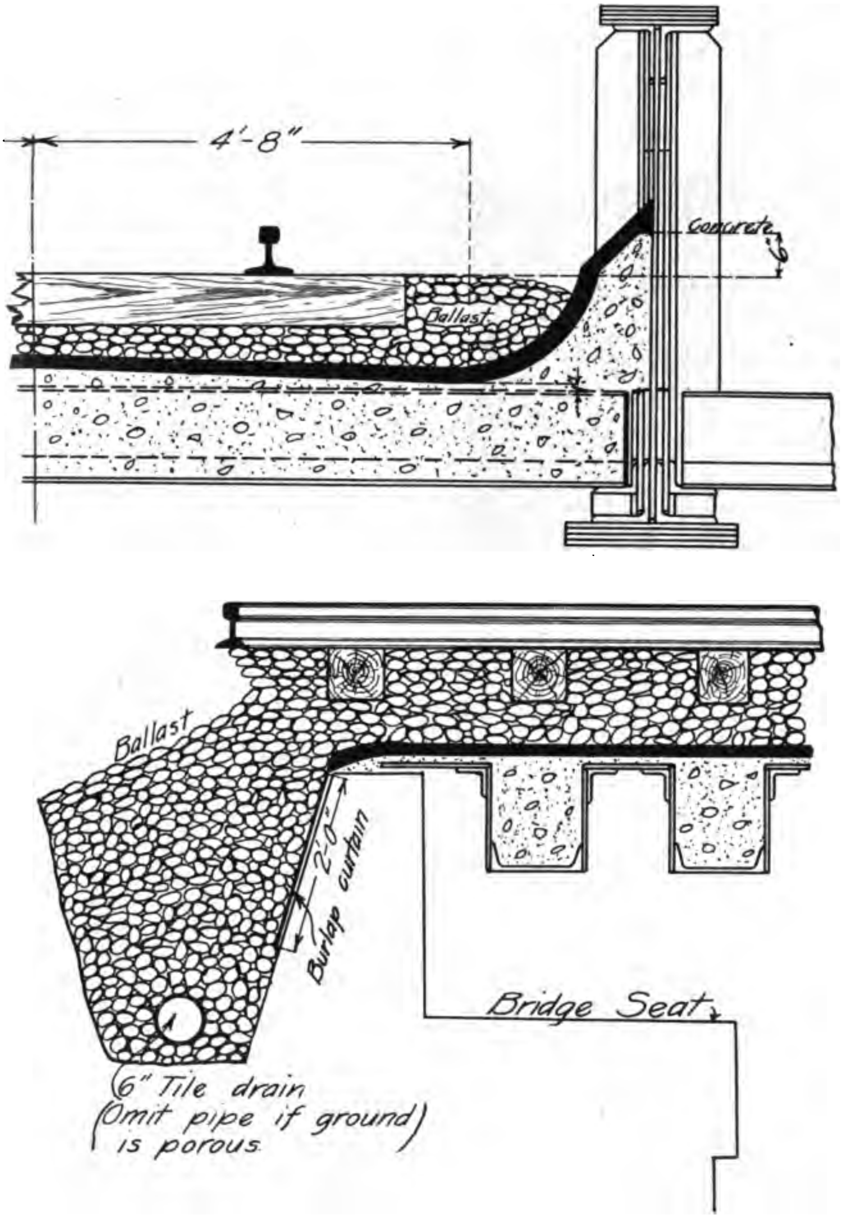


FIG. 2.—Waterproofing of Bridge Floors. New York, New Haven & Hartford R. R.

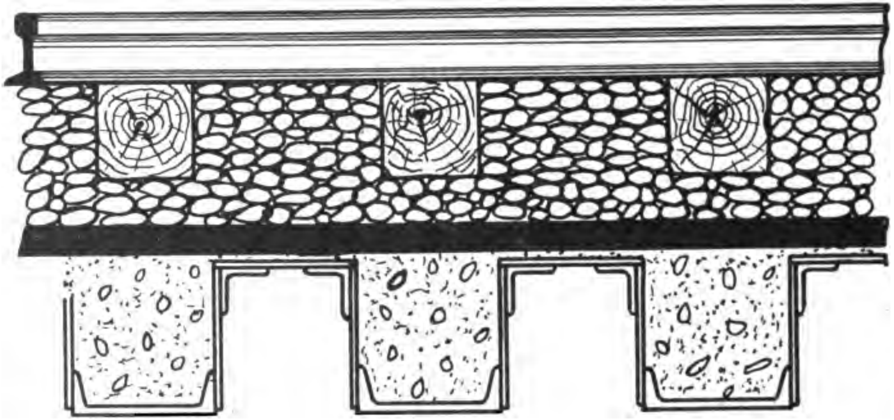


FIG. 3.—Waterproofing of Bridge Floors. New York, New Haven & Hartford R. R.

SPECIFICATIONS :

After surface of concrete has been cleaned, apply a coat of Sarco Concrete Paint. Over this mop a thin coat of hot Sarco No. 6 Waterproofing. On this second coat lay a mastic coat 1¾-inch thick, in proportion of one part Sarco Waterproofing to four parts of sand, or sand and pebbles. Iron to a smooth finish. Over this put a finishing coat of hot Sarco Waterproofing, spread thinly and evenly, and sprinkle with torpedo sand.

Protect expansion joints by a fold of burlap saturated with Sarco No. 6 Waterproofing.

Carry the water back of the abutments by a curtain of burlap saturated with Sarco No. 6 Waterproofing.

a water guard is used, as in the well-known Hydrex system, while in some cases the water guard is omitted and the adhesion of the waterproofing to the web of the girder depended on to maintain a tight joint.

C. In trough floor bridges of three or more spans where the expansion has to be taken care of in the troughing, we have put in special construction with copper flashing to make allowance for the expansion. This construction, however, has not been in service long enough for us to know whether it will be entirely satisfactory or not.

D and E. These questions are answered by the specifications which appear on the drawings.

F. The waterproofing is protected from the stone ballast either by a layer of brick work or by a layer of mastic, 1¾ to 2-inches thick.

G. We have not tried other methods with satisfactory results.

F. E. King, Chicago, Milwaukee and St. Paul Railway:

A. In none of the work done under my direction have trough floors been used. Our solid floors are usually constructed by using I-beams encased in concrete for spans of considerable length. For spans up to about 20 feet we generally use a reinforced concrete slab.

B. About using a girder span; a great many of our girder span bridges are decked with concrete. Where deck spans are used and the conditions will not permit the deck being built in place, slabs of about three feet in length for the full width of roadway are constructed of reinforced concrete and set in place by means of a derrick car. In setting these, cement mortar is spread on the girders to protect the top of the girder from rust and also to insure equal bearing. The joints between successive slabs are grouted to prevent water from leaking through, proper drains being furnished at the side to take care of the water. In none of the work under my direction have we used any waterproofing on this style of structure. In the case of concrete deck on a through girder bridge, the structure put in under my direction, the deck was built in place. In this structure we did not bring the concrete in contact with the main girder or gusset plates. We left an opening of five inches at the bottom of the slab and four inches at the top, between the concrete and the girder and gusset plates. We have therefore experienced none of the trouble to which you refer.

C. As stated above, I have never put in any trough floors on concrete decks. The question of cracking the waterproofing and the concrete around the gusset plates on through girders has, I understand, come up in connection with bridges not on my territory. I believe we have had some trouble on this score, although I have had no personal experience in the matter.

D. I have used both an asphalt cover on concrete and an asphalt and mastic cover on concrete. The covering used is an asphalt preparation manufactured by the Standard Asphalt & Rubber Co., of Chicago, and sold under the name of Sarco. The method of application is as follows: The concrete was first thoroughly cleaned of all dirt and scales and also thoroughly dried. The concrete was then coated with a priming coat of Sarco; this was applied cold with brushes. Over this priming coat one, and in some cases two coats of hot Sarco No. 6 were mopped. The priming coat furnishes the bond between the concrete and the waterproofing. In cases where this waterproofing was applied to a viaduct (and hence a pavement was laid over the roadway) no protection was provided for this waterproofing other than the sand cushion under the brick. In cases, however, where the concrete was to carry the railroad track, one inch of sand mastic was spread over the waterproofing coat and smoothed down with hot irons. The mastic used was composed of about one part of Sarco to four of sand. In preparing this, the Sarco was heated in closed kettles to the required temperature and the sand added. I am unable at this writing to give you any information as to the results, as in no case has this class of material been used by us for any length of time.

E. On but one job have I ever used felt in connection with waterproofing. That case was a 64-foot reinforced concrete arch. The arch ring was waterproofed with four coats of Barrett's pitch and three layers of felt. The method of application was as follows: The concrete was thoroughly cleaned and dried. Over the concrete a thin coat of hot coal tar was spread. This was followed with a coat of hot pitch; on the hot pitch was spread a layer of felt and mopped down; then a coat of hot pitch and then another layer of felt, and the operation repeated until four layers of pitch and three of felt were applied. Up to the present time this waterproofing has been very satisfactory.

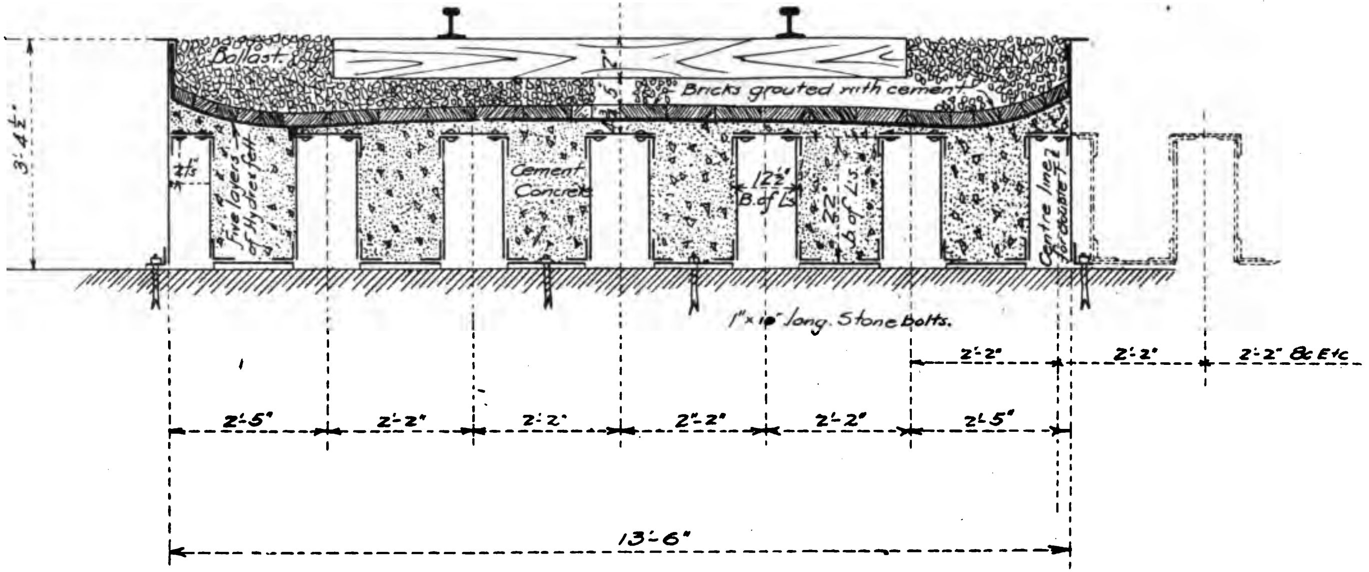
F. We have protected our waterproofing with a coat of sand mastic. This, however, was in places where our ballast came in direct contact with the waterproofing. In case of a culvert deck or arch ring, I see no reason for using a mastic, provided there is a layer of dirt between the concrete and the ballast. In that case, however, the first layer of dirt placed on the concrete should be put on with sufficient care to prevent any stones in the material cutting the waterproofing.

G. I have used no other successful method of waterproofing than those outlined above.

C. W. Richey, Pennsylvania Railroad Company:

A. We use both I-beam and trough section in our solid floor construction, with a preference, however, for the trough floor. Our present standard calls for trough section parallel to the rail for spans up to and including 30 feet. With this arrangement we have a fascia girder on each side of the bridge to hold the ballast.

B. Where solid floor is desired for spans longer than 30 feet we use girders and run the trough section normally to the girders, connection being made directly to the web of the girders. With



Typical Section of Trough Floor System.

FIG. 4.—Waterproofing of Bridge Floors. Pennsylvania R. R.

this arrangement our waterproofing is run above the ballast line, the steel work remaining unpainted until waterproofing is applied, in order to provide proper adhesion.

C. We experience considerable difficulty with all forms of waterproofing used under conditions noted in your question, excepting a waterproofing built up of felt paper.

D. We have used asphalt, pitch and other preparations, usually 1 to 1½-inches in thickness, on the top of a properly troweled cement bed. This method of waterproofing to my mind is unsatisfactory, as it cracks in time, permitting leaks.

E. Our standard at present consists of five alternate layers of Hydrex felt and Hydrex compound, all being placed on the top of the concrete, which has been smoothly troweled to provide proper drainage of water.

F. We protect our waterproofing by means of hard brick laid flat. After being laid it is thoroughly grouted.

G. I know of no other method more satisfactory than the felt covering laid in either asphalt or pitch composition. Expansion or contraction of either the steel or concrete work has no effect on this style of waterproofing.

At our Union Station, Pittsburg, the driveways and Adams express department are under a trough floor system which was originally waterproofed with a 2-inch thickness of asphalt. This leaked very badly and to overcome we applied an additional inch of asphalt, then covered with felt paper, following the Barrett specification for a paper roof.

This piece of waterproofing averages 60 feet in width and is about 275 feet long. Since repairs as above noted were made we have never had a leak.

I am attaching herewith a small tracing showing a typical section through a trough floor system, in which you will note our method of waterproofing and its application.

I. F. Stern, Chicago & North Western Railway:

A. We use the trough system of floor.

B. Where a girder span is used we aim to prevent the water following the lines of the girder by flashing along the side of the girder with asphalt.

C. We have not had any particular trouble on account of the expansion of metal cracking the concrete or waterproofing; we allow expansion joints.

D. After the surface is cleaned of dirt, a swabbing coat of asphalt cut with naphtha is put upon the concrete. I am sending you herewith one blueprint of our drawing, showing standard plan for waterproof covering on track elevation work that covers our method of applying asphalt and mastic.

E. We do not use a felt covering.

F. Occasionally washed gravel is put on top of the mastic on which the ordinary ballast comes, but as a general thing the mas-

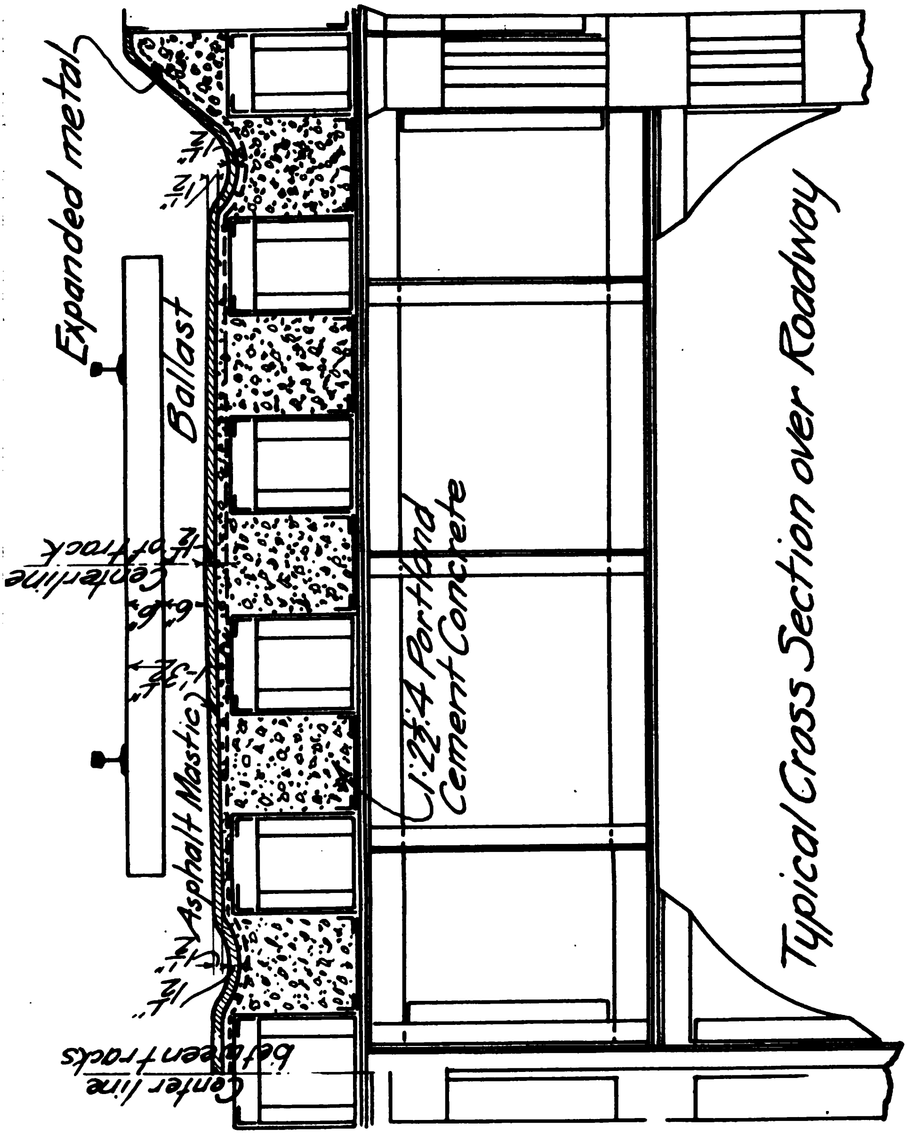

Expanded metal
Ballast
Asphalt Mastic
1:2½:4 Portland Cement Concrete
Typical Cross Section over Roadway
Center line of track
Center line between tracks
6'-6"
3'-2"

FIG. 5.—Waterproofing of Bridge Floors. Chicago & North Western Ry.

SPECIFICATIONS:

The surface of concrete is to be clean and dry, and then to be thoroughly coated with a painting coat of Asphalt cut with naptha or gasoline. On this surface is to be laid 1½-inch of Asphalt mastic made in proportion of one part of Asphalt to four parts of clean sand. This is to be spread in place and well smoothed with smoothing irons. After this is completed, the entire surface is to be swabbed or mopped over with hot Asphalt and sprinkled with sand.

Concrete to be of composition 1:2½:4, the stone to pass through a 1-inch ring with all crusher dust removed. Expanded metal to be laid across tops of floor troughs, and bent for gutters, joints to overlap at least one foot.

tic, which is made in proportions of one to four, is hard enough to withstand any pressure.

R. H. Reid, Lake Shore & Michigan Southern Railway:

A. We use I-beam construction for our solid floor bridges.

B. To prevent water following the line of girder and gussets we use a steel trough lined with concrete and protected with waterproofing; we use solid concrete filling between girders; we carry it up to the top flange and carry the concrete protection up beneath the top flange, as shown in Fig. 6.

C. We have not used solid concrete construction long enough to determine whether we will have any cracking due to expansion and contraction. My opinion, however, is that we will have no trouble from this source.

D. We are now using a gum called Sarco, manufactured by the Standard Asphalt & Rubber Co. of Chicago, and we put on one layer one half-inch thick, putting it on hot. In regard to the results obtained, will say that we hope for the best, but have not used it long enough to give a reliable opinion.

E. We do not use any felt covering over concrete.

F. We protect waterproofing from stone ballast and coarse gravel by a 3-inch layer of fine gravel or sand.

G. We are not at present using any other methods than those outlined herewith, but we have taken out some old iron bridges in which transverse trough sections were used and filled with concrete in which the concrete was so firmly united that we have not yet succeeded in getting it out, although the trough sections have gone into the scrap pile. Apparently the concrete was in as good condition as when put in place.

In the way of general information will say that we have under construction at Keefe and St. Lawrence Avenue, Chicago, at Park Manor Station, two bridges in which we have used steel concrete floor over I-beams with the Sarco waterproofing. It might perhaps interest you to look this over, as they are easily reached from Chicago. I herewith attach two prints of floors which we have recently designed with waterproof protection over concrete.

D. C. Zook, Pennsylvania Company:

A. I have no bridges of this class.

B. I have no bridges of this class that it is necessary to protect with waterproofing.

C. I have no bridges of this class.

D. None.

E. We do not.

F. We do not.

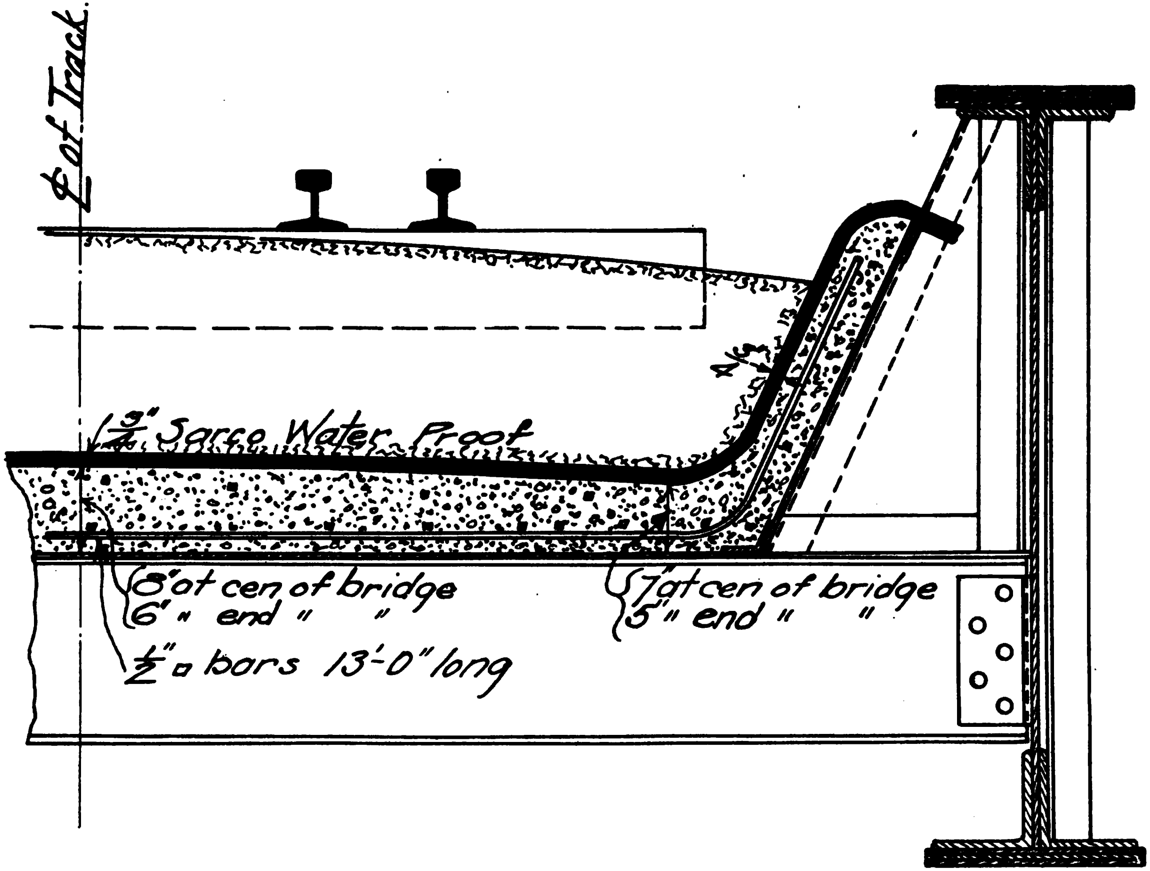


FIG. 6.—Waterproofing of Bridge Floors. Lake Shore & Michigan Southern Ry.

G. I have under my charge at Winona Lake, Ind., a reinforced concrete bridge used as a subway at the station for the use of passengers. This reinforcing consists of 15-inch I-beams, 16 feet long, spaced 18-inches, on centers, the clear span of bridge being 12 feet. The construction of the bridge is as follows: The I-beams were placed in position and the under part of them was covered with wire fabric consisting of No. 10 woven wire, meshes being 3 x 8-inches. The spaces between the I-beams were then filled with concrete down to a point two inches below the bottom of the I-beam, completely covering them with concrete. The concrete was carried up to the top of the I-beams, covering them about one-half inch; on top of this the waterproofing was placed, consisting of one ply Barrett's roofing laid six ply, thoroughly covering each ply with "Barrett's specification coal tar pitch" before the next ply was put on. On top of this waterproofing another coating of concrete was placed, making the thickness in center of span six inches, sloping to the ends of the I-beams, where it was made about four inches, the ends of the I-beams being enclosed in the concrete, which was rounded off so as to shed away the water. On top of this concrete is placed the stone ballast, which is about six inches thick in the center of the span and eight inches thick at the ends of the bridge between the concrete of the bridge and the bottom of the track ties. This bridge has been in service two years and so far the waterproofing has been satisfactory.

J. N. Penwell, Lake Erie & Western Railroad Company, Fort Wayne, Cincinnati & Louisville R. R., Northern Ohio Railway Company:

We are so fortunate as to have only two bridges on our system with tight floors over streets and none over other railroads. We have one at Akron which is covered with ordinary wooden floor laid of ⅞-inch lumber, and the water is conveyed to each end of the bridge, where it is allowed to spill along the side of the grade. This is not an absolutely tight floor.

We also have one over Massachusetts Avenue at Indianapolis which consists of 5-inch creosoted loblolly pine flooring which is laid diagonal on the floor beams and is thoroughly calked and pitched. The water is conveyed to either end and is carried to sewer by means of a downspout which is built in the wall on the rear side. The floor is bolted to floor beams by means of hook bolt and the rail fastened on rail chairs by means of bolts.

Geo. W. Andrews, Baltimore & Ohio Railroad:

A. In solid floor construction we ordinarily use I-beams where we can obtain sufficient depth. Trough floor construction is only used where I-beams cannot be used.

B. For through spans 100 feet and under girders are used, and the water is prevented from following the line of girder and gussets where the adhesion of the concrete and iron is imperfect, by a bent plate riveted to the girder and projecting out over the concrete.

C. We have not had any trouble with the expansion of trough floors cracking the concrete and waterproofing, so far as I know.

D. We have not yet used a mastic to protect the waterproofing, but expect to give this method a trial.

E. We use a felt covering over the concrete, five ply. So far we have used only Hydrex felt laid in Hydrex Hot Compound.

F. This waterproofing felt is protected either by a layer of bricks or a 6-inch layer of concrete reinforced with wire mesh.

A. Montzheimer, Chicago, Lake Shore & Eastern Railway Company:

This year we will have several bridge floors to put in. They are I-beam floors and waterproofing will be laid on top of the I-beams. Concrete and waterproofing will be carried up alongside of gussets and girders, so no water can get in alongside of gussets and girders. Over the asphalt waterproofing will be laid a layer of mastic about three fourths of an inch thick.

We have never used any felt covering for waterproofing concrete.

W. O. Eggleston, Erie Railroad:

A. We use I-beams and rails.

B. No.

C. No.

D. We use a composition of pitch and tar spread on top of concrete.

E. No.

F. No.

G. Nothing.

A. A. Page, Boston & Maine Railroad:

I have no bridges with solid floors on my division, so have not had any experience in that line. I have written several parties, and with two or three exceptions they have had the same experience.

I have a few letters and some prints which I will mail to you under separate cover, which may be of some use. I have also had tracing of a bridge made where the Hydrex system has been used. These I have sent to Mr. Patterson. As far as I have been able to learn, the Hydrex is as good, if not the best now in use.

F. E. Schall, Lehigh Valley Railroad:

The subject of waterproofing has not received much attention on this road on account of not having constructed many solid floor bridges. We have, however, built in one case a solid floor trough bridge. The troughs were filled with concrete and the whole surface of the floor covered with about 1¾-inches additional concrete above the troughs. Four-ply Hydrex felt was then placed over the entire floor, running up on the sides about six inches; then an additional layer of Portland cement concrete cover one inch thick was placed above the Hydrex felt; upon it was placed the stone ballast. In my judgment this is the best way to build solid floor bridges and waterproof them. The steel, where waterproofing is to be done, should not be painted, but should be kept black as it comes from the mill and thoroughly cleaned from rust, to have the Hydrex felt take a firm hold on the material. There are a number of other products, such as Sarco, Minwax, etc., on the market, and no doubt all of them are good for waterproofing if properly placed and of sufficient quantity.

A. F. Miller, Pennsylvania Company:

As chairman of your committee on subject number one, "Waterproofing of Concrete Covered Steel Floor Bridges," I beg leave to submit a report of my experience with the different methods of waterproofing used in our track elevation work in Chicago in the past four years.

In 1904 in the waterproofing of subway bridge floors we used at first asphalt covering ¼-inch thick over concrete. This was found to be ineffective on account of the contraction and expansion, and its liability to puncture. We then used an asphalt mastic made of asphalt and screenings thoroughly mixed in kettles, and applied while hot and thoroughly tamped, after which a ¼-inch layer of pure asphalt was poured over bridge floor on top of the mastic, forming a blanket covering; but on account of the shrinkage when cooling, thus defeating the purpose for which it was intended, its use was discarded on account of ineffectiveness.

The second method tried out by us was concrete, covering the joints of iron work with a substance known as Iron Bark, which was applied to the steel work of bridge with hot smoothing or sad irons, which gave an excellent bond between the steel and the bark. Results very unsatisfactory, the contraction and expansion of steel floor tearing the bark, thus defeating the purpose for which it was intended, and its use was discontinued.

Third method: In the latter part of 1904, at one of our subway bridges on the P., C. C. & St. L. Ry., we made a test of a felt covering over concrete, using three-ply felt thoroughly mopped with a Hydrex compound, over which was placed a layer of concrete 1½-inches thick, sidewalk finish to protect the felt from stone ballast. This method has given us the best result. Care was taken not to allow any adhesion between the concrete and the felt over expansion joints, but was laid as a blanket over the concrete, thus allowing for any irregular contraction or expansion in the metal or concrete covering of the bridge floor proper.

In conclusion would say that the felt method has not given us an absolutely water-tight bridge floor, and that there is still room for great improvement along this line, but we have received the best results from the felt system in our elevation work.

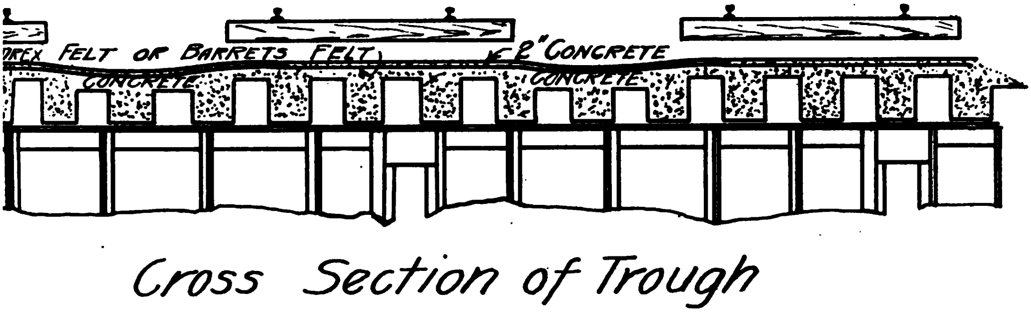
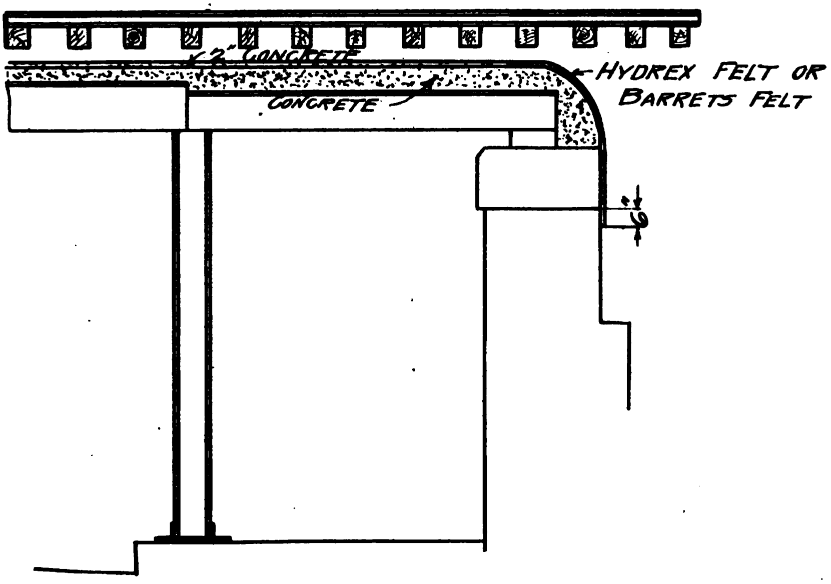


FIG. 7.—Waterproofing of Bridge Floors. Pennsylvania Lines west of Pittsburg.



8.—Waterproofing of Bridge Floors. Pennsylvania Lines West of Pittsburg. Longitudinal Section of Trough.

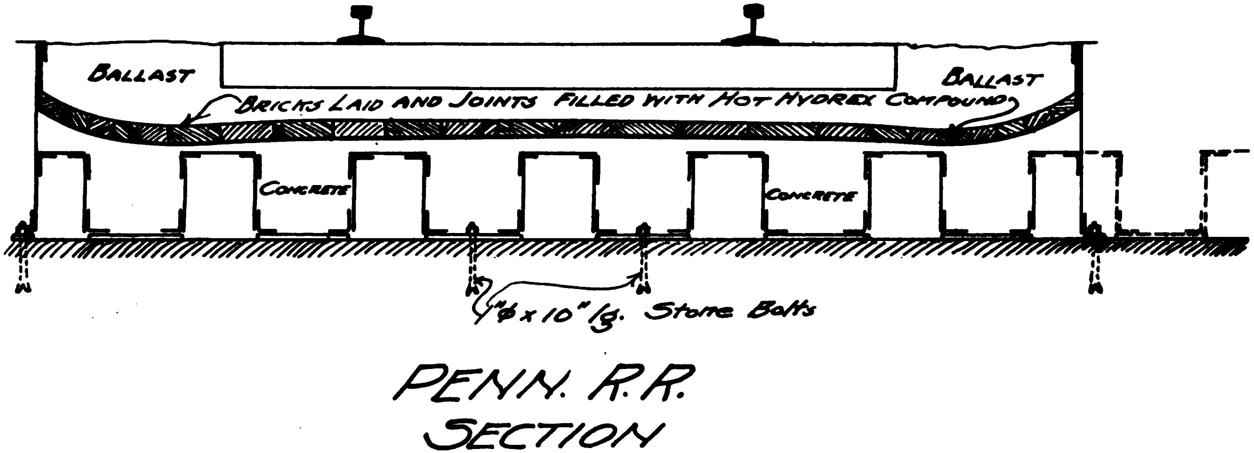

BALLAST
BALLAST
BRICKS LAID AND JOINTS FILLED WITH HOT HYDREX COMPOUND
CONCRETE
CONCRETE
1" φ x 10" lg. Stone Bolts
PENN. R.R.
SECTION

FIG. 9.—Waterproofing of Bridge Floors. Pennsylvania R. R.

W. H. Finley, Assistant Chief Engineer, C. & N. W. Railway:

SPECIFICATIONS AND INSTRUCTIONS FOR WATERPROOFING METAL AND MASONRY STRUCTURES.

MATERIAL.

1. (a) Asphalt shall be used which is of the best grade, free from coal tar or any of its products, and which will not volatize more than ½ of 1 per cent under a temperature of 300° F. for 10 hours.

(b) It must not be affected by a 20 per cent solution of ammonia, a 25 per cent solution of sulphuric acid, a 35 per cent solution of muriatic acid, nor by a saturated solution of sodium chloride. It should show no hydrolytic decomposition when subjected, for a period of ten hours, to hourly immersions in water with alternate rapid drying by warm air currents.

RANGE OF TEMPERATURE.

2. (a) For metallic structures, exposed to the direct rays of the sun, the asphalt must not flow under 212° F., nor become brittle at 0° F. when spread thin on glass.

(b) For structures under ground, such as masonry arches, abutments, retaining walls, foundation walls of buildings, subways, etc., a flow point of 185° F. and a brittle point of 0° F. will be required.

(c) A mastic made from either grade of asphalt by mixing it with sand must not perceptibly indent when at a temperature of 130° F. under a load of 20 pounds per square inch. It must also remain pliable at a temperature of 0° F.

PREPARING SURFACE.

3. (a) Before applying asphalt to a metal surface, it is imperative that the metal be cleaned of all rust, loose scale and dirt; and if previously coated with oil this must be burned off with benzine, or by other suitable means. The metal surface must be warm to enable the asphalt to adhere to it, and the warming is best accomplished by covering it with heated sand, which should be swept back as the hot asphalt is applied.

(b) When waterproofing masonry structures, if the surface cannot be made dry and warm, it should be first coated with an asphalt paint applied cold. This is particularly necessary for vertical surfaces. It is difficult to make either cold or hot asphalt adhere to the surface of concrete or mortar when the latter is covered wih a thin film of cement. To overcome this the surface of the structure should be covered with a finishing coat of mortar composed of one part of cement to one part of sand. If this is not permissible the surface should be cleaned with a sand blast.

PREPARING ASPHALT.

4. The asphalt should be heated in a suitable kettle to a temperature not exceeding 450° F. If this is exceeded it may result in "pitching" the asphalt. Before the "pitching" point is reached

the vapor from the kettle is of a bluish tinge, which changes to a yellowish tinge after the danger point is passed. If this occurs the material should be tempered by the addition of fresh asphalt. The asphalt has been cooked sufficiently when a piece of wood can be put in and withdrawn, the asphalt clinging to it. Care should always be taken not to prolong the heat to such an extent as to pitch the asphalt; should it become necessary to hold the kettle for any length of time, bank or draw the fire and introduce into the kettle a quantity of fresh asphalt to reduce the temperature.

APPLICATION OF ASPHALT.

5. (a) The first coat should consist of a thin layer poured from buckets on the prepared surface and thoroughly mopped over.

(b) The second coat should consist of a mixture of clean sand or limestone screenings, free from earthy admixtures, previously heated and dried, and asphalt, the proportion of one part asphalt to three or four parts sand or screenings by volume; this is to be thoroughly mixed in the kettle and then spread out on the surface with warm smoothing irons, such as are used in laying asphalt streets. The irons should not be hot enough to burn the asphalt.

(c) The finishing coat should consist of pure hot asphalt spread thinly and evenly over the entire surface, and then sprinkled with washed roofing gravel, torpedo sand or stone screenings, to harden the top.

(d) The entire coating should not be less than one inch thick at the thinnest place.

BY AUSTIN LORD BOWMAN.

To the Association of Railway Superintendents of Bridges and Buildings:

METHOD OF APPLYING WATERPROOFING.

First. The steel floor plate was thoroughly cleaned and painted with one coat of red lead and oil.

Second. A filler of Mastic Asphalt was placed along the webs of the girders.

Third. Five layers of Hydrex Felt cemented together with Hydrex Compound were then put on the floor plate and carried as far as possible up under the flashing angles, which were fastened along the webs and around the stiffeners and the ends of the girders. The felt was not cemented to the floor plate but was thoroughly cemented to the webs of the girders.

Fourth. A layer of brick laid flat was then placed on the felt in a hot layer of compound, the brick being laid lengthwise of the bridges.

Fifth. The joints between the brick were thoroughly poured with compound and the whole surface mopped with compound.

Sixth. The stone ballast ties and rails were then placed on the bridge.

LABOR AND TIME ON WATERPROOFING AFTER STEEL WORK WAS ERECTED.

The skilled and common laborer employed per square (100 sq. ft.) was as follows: Foreman, 1.66 hours; waterproofers, 11.71 hours; laborers, 7.75 hours.

The overtime to complete a floor of 750 square feet was 1.4 days of 10 hours. The best time for one track, 750 square feet, was one day of 10 hours.

COST.

The cost of waterproofing materials per square foot of floor surface was 20¾ cents.

The cost of labor per square foot was 10¾ cents.

Materials per square (100 square feet): Brick, 440; Hydrex Compound, 41.2 gallons; Hydrex Felt, 1.46 rolls (400 square feet per roll).

RESULTS.

The bridges are watertight with the exception of a few points immediately over columns.

During a severe storm the water leaks down to some extent, between the main and side walk girders. It seems impossible to keep these points absolutely tight.

The vibration and reflection of the girders break the bond of any material which is placed between the ends of the girders. From a close observation of these bridges it seems impossible to make the compound adhere to the steel for any length of time, due

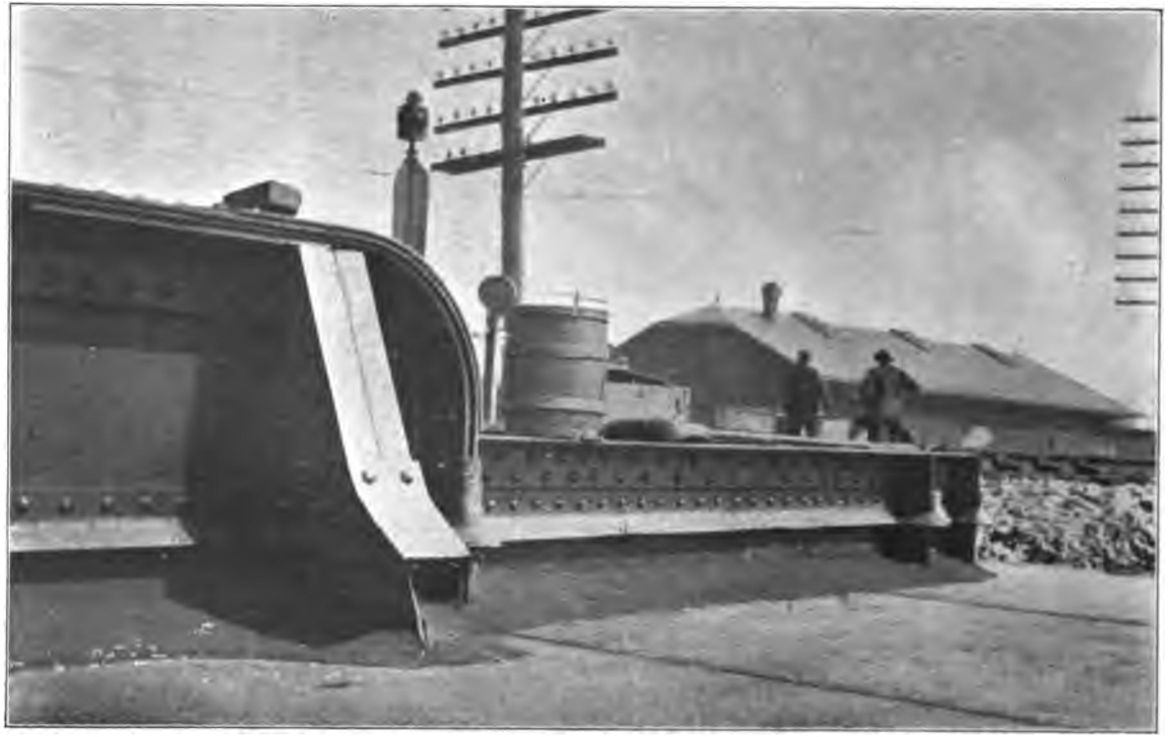


Fig. 10.—Waterproofing of Plate Girders, "Hydrex Method," showing Water Guard around Stiffeners, Gussetts and Ends of Girders, Central R. R. of N. J.

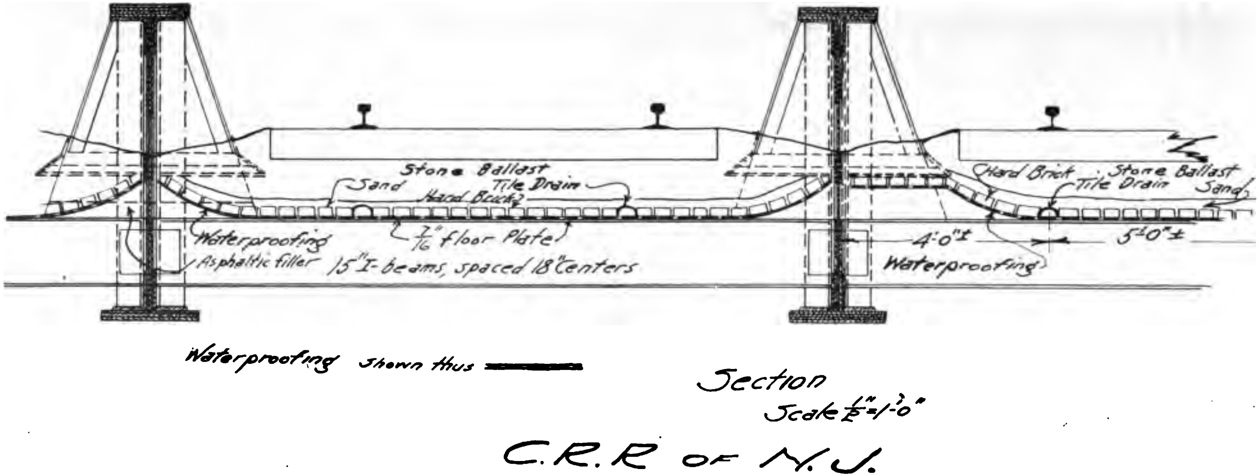


FIG. 11.—Waterproofing of Bridge Floors. Central R. R. of New Jersey.

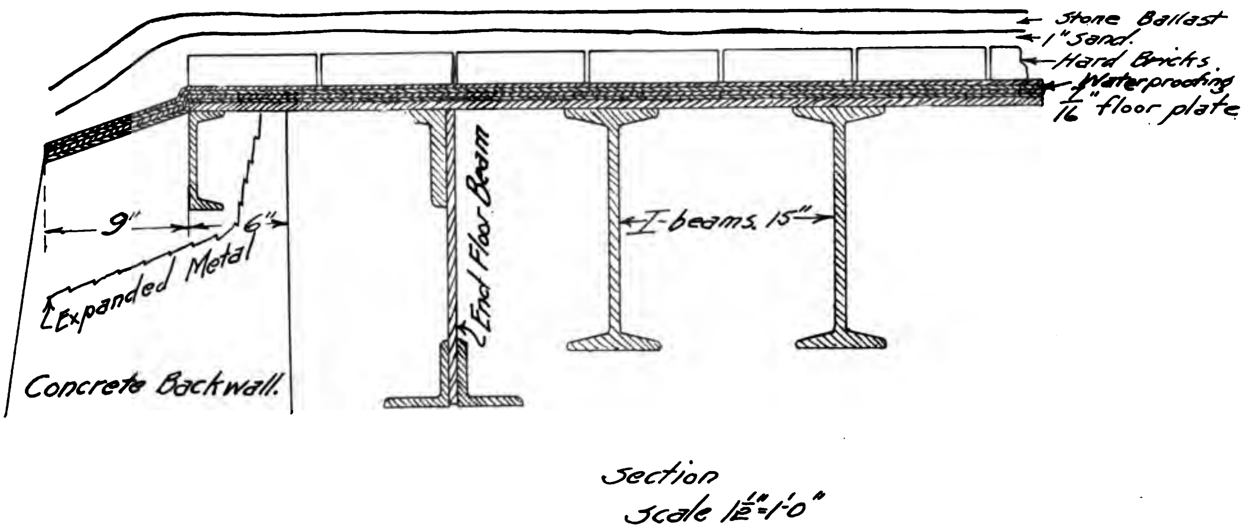


FIG. 12.—Waterproofing of Bridge Floors. Central R. R. of New Jersey.

to the vibration of the steel work and the hardening of the material during cold weather.

It is necessary to protect the edges of the waterproofing along the girders from water running down behind after the waterproofing has broken loose. This was done by means of the flashing angles referred to above.

No attempt should be made to fit the brick along the web or brackets, the brick being simply shoved as tight as possible and then the openings poured with the compound. Afterward the opening under the flashing angles should be filled with concrete to keep the edges of the felt from curling over.

The felt was carried well over and down the back walls, drainage being had by putting the bridges on a grade and allowing the water to run behind the abutments, which were drained by pipes running through the abutments to the gutters.

Of the six bridges referred to above five were very near together and so were erected in one group. The sixth was quite a distance away and was erected separately, so as to throw as little track out of service as possible.

All track changes were made by means of crossovers at each end of the groups of bridges to be erected. These crossovers were operated by switchmen and operators stationed at each group. And in addition the signals governing them were incorporated in the Electro Pneumatic Signal System of the road.

(No Discussion.)

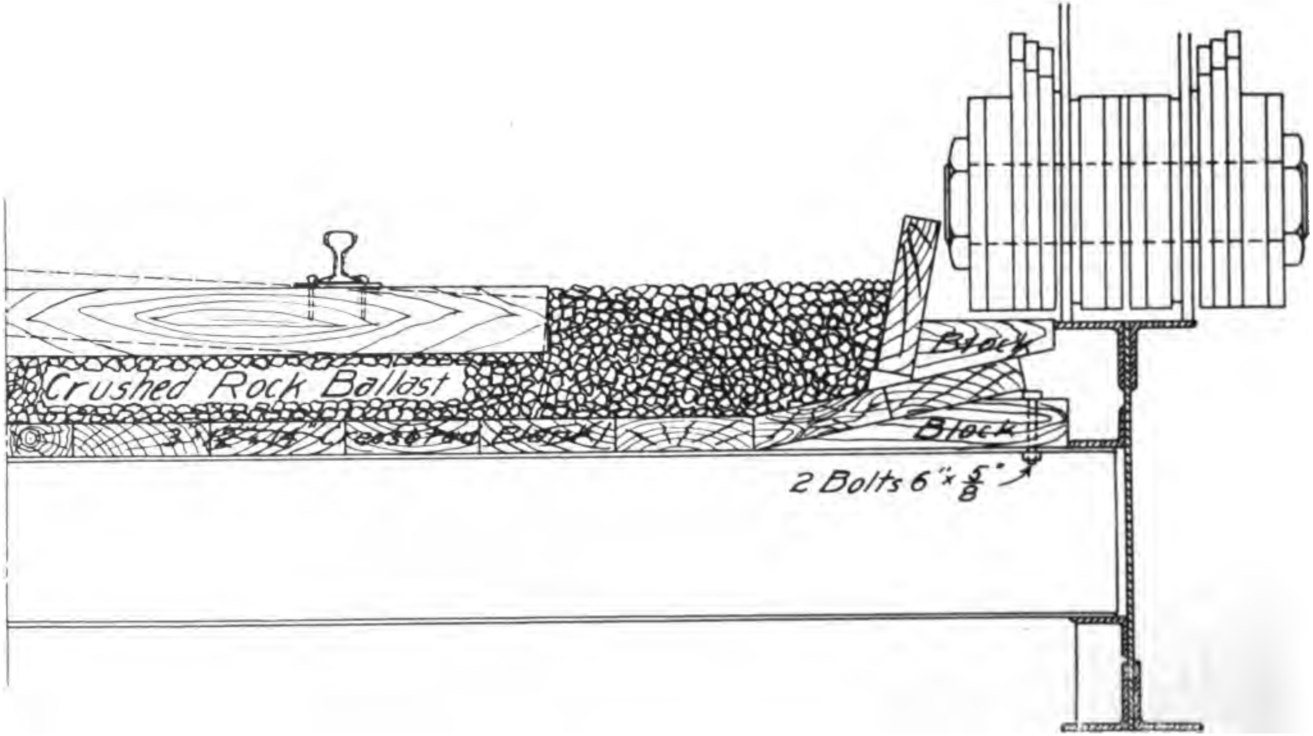


Fig. 13.—Waterproofing of Bridge Floors. Southern Pacific Co., Los Angeles, Cal.

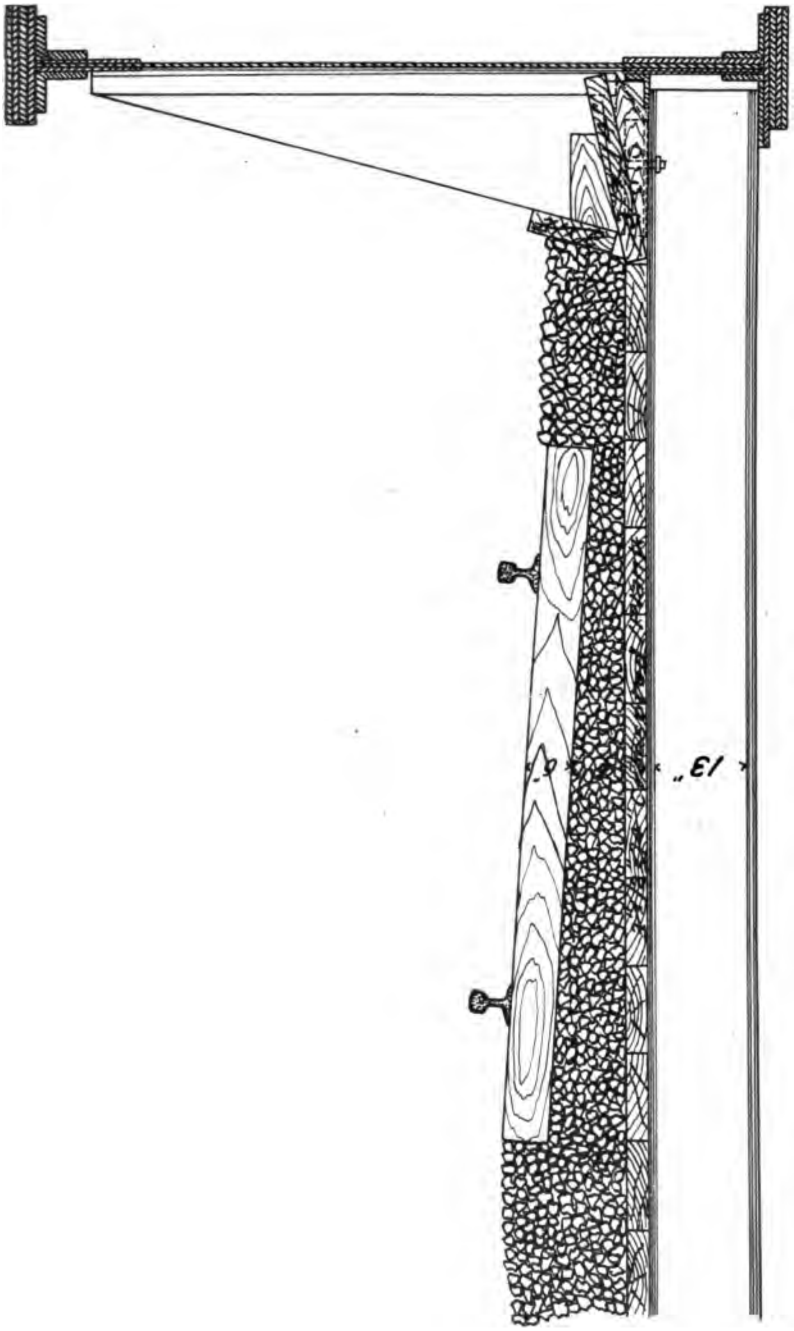


Fig. 14. Waterproofing of Bridge Floors. Southern Pacific Co., Los Angeles, Cal.

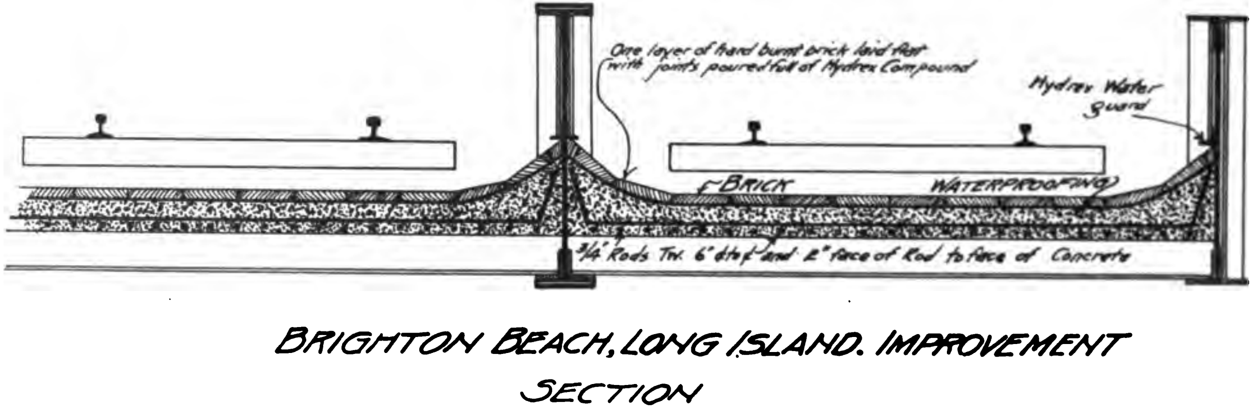

One layer of hard burnt brick laid flat with joints poured full of Hydrex Compound
Hydrex Water guard
BRICK
WATERPROOFING
3/4" Rods Thr. 6" c to c and 2" face of Rod to face of Concrete
BRIGHTON BEACH, LONG ISLAND. IMPROVEMENT
SECTION

FIG. 15.—Waterproofing of Bridge Floors.

II.

MODERN EQUIPMENT AND TOOLS FOR ERECTION OF STEEL BRIDGES.

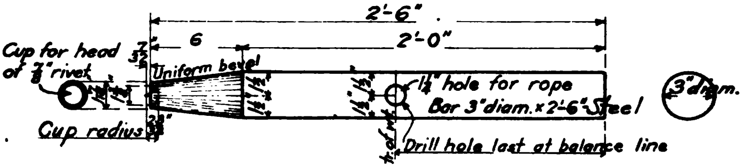
REPORT OF COMMITTEE.

To the Association of Railway Superintendents of Bridges and Buildings:

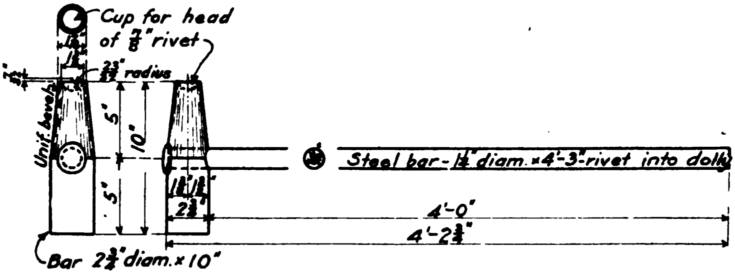
I consider a derrick car the most economical and quickest tool in erecting both deck and through spans up to two hundred feet in length; and it is economical also for erection of deck and through girders. For erecting viaducts, I consider the use of a stiff leg derrick on rollers operated on top of the falsework the most economical.

Tools Required for Erecting Spans and Girders.

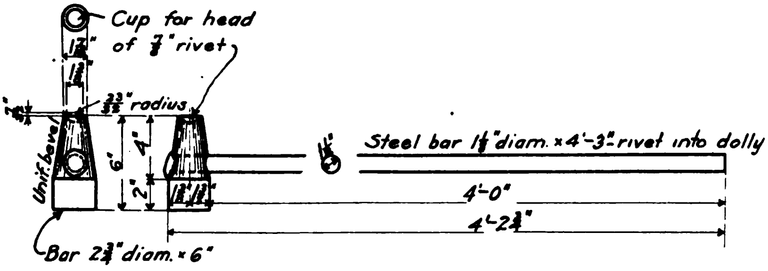
16 lb. sledges.
7 lb. hammers.
4 lb. hammers.
Snatch blocks.
Tackle blocks with lever for heavy loads, from one to three sheaves; shells from 8 to 16-inches.
Manila rope from ⅝ to 1½-inches.
Hand made chains from ¾ to 1¼-inches, some with hook on one end and some with link on both ends, these to be made so one will pass through the other.
Steamboat ratchets.
Ball bearing and screw jacks.
Stone drills.
Ratchets—Old men and drills.
Reamers.
Hack saws and frames.
Cape chisels.
Fluted chisels.
Handle chisels.
Claw bars.
Pinch bars.
Key wrenches.
Fitting up wrenches.
Socket wrenches.
Monkey wrenches.
Grind stone and grinding machine.
Cross cut saws.
Hand saws.
Adzes.
Augurs.



JAM DOLLY

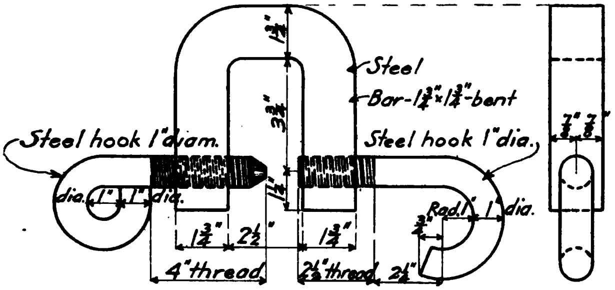


LARGE SPRING DOLLY

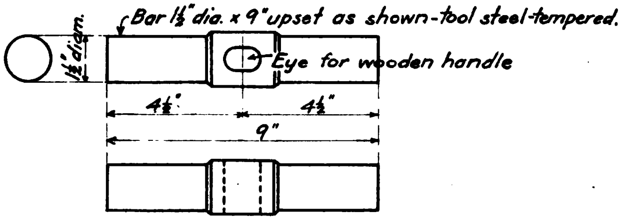


SMALL SPRING DOLLY

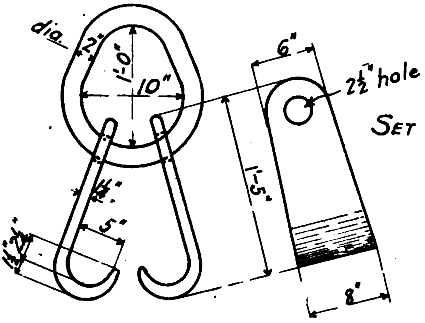
FIG. 16. Tools made in Chesapeake & Ohio Railway Company's Shops.



Riveting Clamp



Rivet Flogging Maul



Set of Girder Clamps

FIG. 17. Tools made in Chesapeake & Ohio Railway Company's Shops.

Files.
Chopping Axes.
Hand axes.
Timber trucks.
Cant hooks.
Carrying hooks.
Square.
Level.
Vise.
Pipe and Stilson wrenches.
Stocks and dies.
Shovels.
Picks.
Track gauge.
Drift pins—different sizes.
Rivet shears.
Girder hooks.
Stringer hooks.
Forges.
Rivet tongs.
Bar busters for cutting out rivets.
Hand busters for cutting out rivets.
Backing out punches.
Snaps or button sets.
Bar snaps.
Spring dollys for holding up rivets.
Heel dollys for holding up rivets.

Committee {
J. Hunciker, *Chairman.*
W. H. Wilkinson,
G. J. Klumpp,
B. F. Pickering,
A. E. Killam.

DISCUSSION.

Mr. Steffens.—It seems to me that the whole value of this report would depend on plans. I would suggest that it would not be very difficult to obtain from the members sketches at least from which plans could be made for the tools as listed in this report. I was confronted with this problem some time ago and was compelled to draw a set of plans which I will be glad to send in if the other members will do likewise. If we as an Association would publish a full list of these tools with illustrations it would settle the matter once and for all.

President.—It might perhaps be a good idea for members to forward to the Secretary any plans which they may have of tools.

Mr. Killam.—I was asked for information by the committee handling this report. I went to the trouble of going to our bridge men and getting all particulars and making plans which were forwarded to the committee, but they do not appear in the report.

President.—It might be worth while to follow this matter up.

As there was no further discussion the session was adjourned.

III.

PROTECTION OF STRUCTURES AGAINST EFFECTS OF ELECTRIC CURRENTS.

(No report and no discussion.)

IV.

PROTECTION OF EMBANKMENTS FROM THE EFFECT OF HIGH WATER BY RIPRAP OR OTHERWISE.

REPORT OF COMMITTEE.

To the Association of Railway Superintendents of Bridges and Buildings:

Your committee on subject number four, "Protection of embankments from effect of high water by riprap or otherwise," begs leave to make the following report:

We have written to several of the members and have received an answer from only one. I append his remarks to the report. As the report is now made (beside the one letter appended hereto) you have the experience of but three members.

Riprap on the Pittsburg & Lake Erie Railroad is a very important matter, as this road runs close to the banks of the Mahoning, Ohio, Youghiogheny and Monongahela rivers at several points between Youngstown on the Mahoning River, New Haven on the Youghiogheny River, and Brownsville on the Monongahela River, for a distance of 165 miles along these rivers.

At some points where riprapping is required and the tracks are far enough away from the harbor line to permit, the work is done by throwing the stone over the bank, letting them roll or slide down, making a slope about 1½ to 1, slope varying in thickness from two feet to four feet. We use for this, quarry spalls or small stone such as can be handled by one man, and in some cases we use furnace slag, which becomes hard from the effects of the weather and makes very good riprapping. This costs from one to two dollars per square yard.

At points where we are close to the harbor line, we use stone such as can be handled by one man and laid in place by track laborers on a slope of 1 to 1, varying in thickness from two to three feet, costing about three dollars per square yard. Herewith please see sketches of riprapping where stones are laid in place along the banks of the Ohio and Monongahela rivers at Pittsburg.

In riprapping piers and abutments of bridges we use in some cases, where the current is not very rapid, small stone such as can be handled by one man, and where the current is very rapid we use large breakwater stones, usually dropping them around the piers or abutments, allowing them to find their own bearing.

In all cases I would prefer the large breakwater stones, filling up the crevices between the large stones with small ones and making the riprap as compact as possible to prevent any washing.

F. Ingalls, Supt. B. and B., Northern Pacific Railway Co.:

On most waterways of the Northern Pacific Railway through the prairie country of North Dakota we use boulders which can be picked up on the prairie and loaded on cars for one dollar per cubic yard and placed for 75 cents per yard. We also use stone for protection of banks from wave wash where permanent protection is required. For temporary protection at times of occasional high water we use sand bags and fascines.

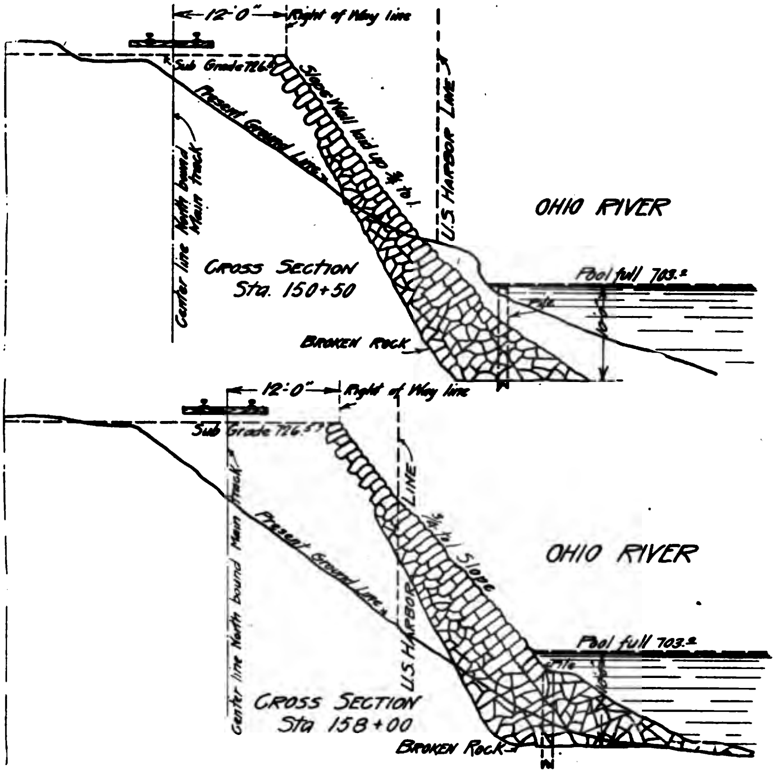


FIG. 18.—Slope Walls on River Banks. Pittsburg & Lake Erie R. R., Pittsburg, Pa.

Portable snow fence is also used in emergencies. This fence is made in panels 16 feet long, and, when placed along the bank, will break the force of the waves.

At one place, where we have a mile of track exposed to occasional wave wash, we have sodded the banks, but have had no high water there since the banks were sodded, so we cannot say what the benefit will be, but believe it will give good protection. At the crossing over the Missouri River we have experienced all kinds of trouble from bank cutting for approximately two miles above the bridge. The bridge itself is protected by dykes built of piles, fascines and rocks. For the protection of banks above the bridge, dykes were built of mattresses composed of willows and stone and held in place by piling. Most of this work was done by the government, as the cutting of the banks endangered Mandan on the west side of the river and would also have destroyed the harbor for boats at Bismarck on the east side of the river.

J. S. Berry, Supt. B. and B., St. Louis Southwestern Railway Co.:

We have used several methods for protecting embankments on our line from caving on rivers which are considered as very difficult streams to control, the most difficult ones being the Mississippi River, Arkansas River and Red River. One of the first methods is to slope embankments to pitch of three to one and drive piling at toe of slope about fifty feet apart; then weave mattress of willows of sufficient length so that they will reach from toe of slope out into river about fifty feet. Mattresses are then sunk with rock and placed in proper position and the entire bank is riprapped with rock all the way and about ten feet at the top of bank, so that high water cannot cut in behind it.

I consider this method of bank protection practical, as it has proven satisfactory. It will cost approximately $8 per running foot of embankment.

We have been using another method, which has proven very effective, this being to drive deflecting dykes. Piles are driven about eight feet apart, and dykes spaced about thirty feet; 2 x 6 planks are spiked onto piles about six inches apart from the top of piling to bottom of stream. These deflecting dykes will collect the debris and the chambers will gradually fill in and form a bar. I also consider this method effective in case of very rapid currents and will cost approximately $6 per lineal foot complete.

There are other methods being used, and some of them are quite effective. There is what is known as the system of mud-rafts and hollow fascines. These are generally constructed out of willows and poles, then put into proper position and anchored. They will gradually fill in with sand and silt from high waters and sink in place, and embankment usually fills in behind it. It also has a tendency to check the current. However, this is expensive work, costing $9 per lineal foot. The mud-rafts cost about $6. I regret that I am unable to furnish you with proper sketches describing the various methods, but I can not do so at the present time.

Committee {
G. H. Soles, *Chairman*,
J. C. Beye,
R. C. Sattley,
J. S. Berry,
W. B. Rogers,
F. Ingalls.

APPENDIX.

R. H. Reid, Supr. of Bridges, L. S. and M. S. Ry.:

During the present spring we have been obliged to do considerable riprapping on our lines in southern Michigan and northern Indiana on account of high water, not only to protect embankment but to protect masonry; in many cases the bottom of the stream was washed out so low that it was necessary to fill in in order to keep our masonry safe. This filling was done generally with breakwater stone, cobble stone, or what we call shell stone or quarry spalls.

In the case of very rapid currents, we use generally breakwater stone. Where the current was not so swift, we use cobble stones or quarry spalls or shell stone. Breakwater stone was generally placed with a derrick, being unloaded from car and placed direct where it was needed. In some cases holes were filled in with breakwater stone and smaller stone laid on top of them to give a little smoother bed and prevent churning.

We have other cases where banks have been riprapped for protection against water at ordinary stages, riprapping being placed at the time banks had been built.

In these cases we generally use large, flat breakwater stones laid so as to make a sort of pavement or smooth surface on top. In locations where quarry stones cannot be readily had, cobble stones can be used to good advantage for much of the riprap by being careful to lay them so as to form a pavement for ordinary bank protection and filling in the holes where bottom has been scoured. For heavy wash and very rapid streams, however, I think the large breakwater stone is preferable.

DISCUSSION.

Mr. Steffens.—In connection with this subject I will mention briefly a case that I am meeting just now. In crossing some of the long ravines at river openings it is a very expensive matter to build either a long structure or to build bank abutments on the line of what might be called the normal opening. Some of these openings would probably require 80-foot piers if they were used, which is clearly out of the question. In order to accomplish the crossing in an economical manner we are planning to fill out to where abutments would naturally be placed, using select material, so that at the end of some years, after the bank has settled, we can construct a concrete abutment. This construction will require very heavy riprap to protect the banks against the heavy flow of water in flood season. We shall probably have to use riprap larger than usual—derrick stone for instance. This form of construction I have not seen used elsewhere and thought it worth mentioning, as it bears particularly on the protection of embankments by riprap as the integrity of the banks will depend upon the riprap that we place there.

Mr. A. S. Markley.—Some fifteen years ago the Wabash River washed out its south bank, which threatened the abutment of one of our bridges. On account of curve in the stream above this point, running at a tangent, the river flowed close to the bank. The distance to be protected was about seven hundred feet. To riprap with stone alone would require a large amount of stone, which was not very plentiful along the line. To overcome this we first sloped the bank at an angle of 30 degrees with the water line, and then covered the slope with a three-foot layer of brush and long young trees, these being placed in successive layers at right angles to each other, the lower layer and the last layer on top being at right angles to the river, the whole protection extending from below the low water line to the top of the bank. In the first layers small willow trees were secured, laid with butts extending below low water well out in the stream. These have grown as well as other varieties, forming a good protection for the bank. In order to prevent the brush from washing away in high water, sufficient stone was placed on it and dirt filled over the brush to assist the stone in holding the brush in place.

Mr. Spencer.—We have a good deal of riprapping to do and there are two ways in which I can make it hold in our swift streams. One advantage that we possess is lots of stone. We can find it anywhere for the cost of picking it up. We use blocks sometimes weighing a ton or more and then drop in lighter stones among them. Another method is to get some big stones and place them with a derrick in jetties. Sometimes a timber crib is used, which is in almost every case absolutely safe, but it is pretty expensive.

Mr. A. S. Markley.—Oue method I have used successfully is to drive piles three feet apart, letting them extend two or three feet above high water at a much sharper curve than the stream makes, or at an angle of forty-five degrees, with the bank where same is on a tangent. An eddy forms behind the piles where sediment settles, filling up the space between the piles and the bank and thus preventing further washing of the bank.

Mr. Montzheimer.—I would like to ask Mr. Steffens what length of bridge he is going to put over those openings.

Mr. Steffens.—As a rule the spans will be under 100 feet. There is another connection in which riprap is used, and that is around piers when there is high water that is causing scour. The old-fashioned method is to pile the riprap promiscuously around the piers. A more scientific method would be to pile it a short distance from the pier so that as the stream removes the softer material the riprap will fall into the cavity thus formed and form a new bed of the stream, free from further erosion.

President.—One thing that comes up occasionally is, as

Mr. Steffens suggests, protection during high water. Last spring we had scour where we never had it before, and we had about all the equipment that we could spare hauling breakwater stone and slag for some days to protect our masonry and also some timber structures. We dumped the stone around the piers and worked them under where we could, and in several cases where there was bad wash we used breakwater stone and placed them with a derrick.

Mr. Spencer.—We had to protect a place of that kind and used stones of the size one man can handle, placing them on brush, which we wired together and dropped into the hole. If you drop enough of this into a hole it will stop the cutting.

President.—Is there anything further on this subject? If not, we will pass to the next.

V.

EXPERIENCE IN THE USE OF GASOLINE ENGINES AND KEROSENE ENGINES OR COMBINATIONS OF SAME FOR WATER SUPPLY, DRAWBRIDGES, ETC.

REPORT OF COMMITTEE.

To the Association of Railway Superintendents of Bridges and Buildings:

In reporting on this subject, so far as the use of gasoline engines in connection with water supply is concerned, your Committee begs leave to refer to the report of the Committee on "Best and Most Economical Plant for Pumping Water for Water Stations," as given on page 75 of the Proceedings of the Ninth Annual Convention, October 17–18, 1899. It is as largely true now as it was then, that a careful study of the conditions surrounding a water station must be made before it is possible to determine the best type of plant which should be installed.

Since the report above referred to was made, the operation of the gasoline engine is even more successful and satisfactory, because of improvements made in design and because it is better understood by the public generally.

The cost of fuel determines in a large measure the type of plant to be used. There is no saving in using gasoline, instead of coal, where the labor of operator required cannot be used in connection with other work; however, the simplicity of installation and ease of operation of gasoline pumping plants make such systems preferable for water stations, in some situations.

Kerosene, which has a heat value 10% greater than that of gasoline yet costs only about one-half as much, is being used in internal combustion engines, designed for gasoline as a fuel, with some success. It appears, however, that some modification in the cooling system is necessary in order to keep the temperature of the cylinder higher and that the engine must be started with gasoline in the usual manner. Also, because kerosene is not as clean, closer attention is required in keeping ignitor and various parts clean.

As a general proposition, it is evident that some form of power which is always ready for instantaneous operation and which can be used intermittently without any expense for energy is preferable for drawbridges.

Your Committee sent out a number of inquiries with reference to this subject and a resumé of the replies received is given herewith. Inasmuch as there are now many members of this association who are not familiar with the report on "Best and Most Economical Plant for Pumping Water for Water Stations," as given in the proceedings for 1899, and as that subject is very closely allied with this one, we think it best to include here, also, extracts from that report, as shown on page 86.

Concerning the use of kerosene in engines, Mr. F. Von Schlegell, of Fairbanks, Morse & Company, writes as follows:

"Kindly refer to our catalogue No. 44D, page 17, on which we show a 25 H. P. engine fitted for the operation on kerosene. On the subject of the use of kerosene in such engines this can be said:

"First, inasmuch as kerosene, gasoline and alcohol are always purchased by the gallon their value as fuels should always be considered with regard to their volume rather than the misleading standard of weight. Kerosene contains about 10% more heat units per gallon than gasoline and about 50% more than alcohol. Kerosene further costs about 55% as much as gasoline, and there is a constant tendency for the price of kerosene to go down and for gasoline to go up, because the market for gasoline has widened on account of the automobile trade and general gasoline engine business, with the result that kerosene is becoming more and more of a bi-product due to the production of gasoline and with the proportionally lessening demand account of the fact that so many small towns are now putting in electric lights where formerly they used kerosene lamps.

"Naturally enough there has been a desire to use kerosene for power purposes in internal combustion engines, but it has not met with the success which could otherwise be hoped for, first on account of the fact that kerosene being less volatile than gasoline will not remain in suspension or cannot be handled through the ordinary form of carburetor under varying weather conditions as successfully as gasoline. Another difficulty is the trouble in getting pure kerosene and the effect which kerosene has on the lubrication.

"Now, in order to get the kerosene to remain in suspension and to overcome the carburetor feature, we have used the kerosene with our regular mixing apparatus, which as you know is fitted to the cylinder head, and in order to prevent its precipitation on the cylinder walls, we have arranged a modification in the ordinary cooling system by which the bottom of the cylinder is not cooled more than the top and the general temperature of the cylinder walls is kept higher. This is accomplished generally by us by passing the cooling water first through the water which has been around the cylinder jacket before it strikes the cylinder. We also provide means of regulating the air supply.

STATEMENT OF COST OF PUMPING WATER.

(Condensed from Report of Committee V, Proceedings of 1899.)

Date 1899.	Engine.		Pump.		Suction.		Discharge.		Period of Pumping—(hours).	Fuel.	Amount of Fuel (gallons or pounds).	Water pumped (gallons).	Fuel per 1000 gal. of water (gal. or lbs).	Cost.		
	Make.	Size.	Make.	Size.	Vertical.	Horizont'l	Vertical.	Horizont'l						Fuel per 1000 gal. of water pumped.	Labor per 1000 gal. of water pumped.	Total for 1000 gal. of water pumped.
May 5	Otto	6 H. P.	Curtis.....	5''x15'	10'-25'		39.8'	2600'	6	Gasoline..	2.9	26,965	.1075	$ .01075	$.01196	$ .02271
Sept. 1	“	10 H. P	“	6''x18''	13'	200'	68'	1000'	4	“ ..	2.25	36,180	.062	.0062	.00891	.01511
Sept. 4	“	“	“	“	“	“	“	“	3.5	“ ..	2.714	31,320	.0862	.00862	.01030	.01892
March	F.M. & Co.	3 H. P.	Comb'n ..		10'-25'		35'	300'	131.6	“ ..	55.375	532,560	.104	.0104	.01088	.02128
March	Stewart...	6''x10''	Stewart...	5''x10''	20'	200'	56'	1000'	38	Screenings coal	94.9	360,720	26.308	.00775	.0219	.02966
March	“	“	“	“	“	“	“	“	40	Lump coal	79.4	320,760	24.769	.01114	.0246	.03574
March	“	“	“	“	“	“	“	“	43	Screened coal	84.25	342,900	24.569	.00827	.0231	.03137

TABLE 1.—Statement of cost of pumping water. C. & E. I. R. R.

A. S. Markley, Chicago and Eastern Illinois Railroad:

"Following are the results of some tests made to determine the cost of pumping water at several of our water stations. The results obtained for the steam plants are given merely for comparison with the gasoline-operated plant:"

WATER STATION.	Oxford.	Winthrop.	Tamms.
Date	Oct., 1900	Oct., 1900	1901
Make of engine	Stewart	Stewart	Stickney
Size of engine	6"x10"	6"x10"	
Make of pump	Stewart	Stewart	Stickney
Size of pump	6"x10"	5' x10"	
Vertical suction	15'	15'	20'
Horizontal suction	30'	30'	15'
Size of suction pipe	4"	4"	6"
Vertical discharge	45'	45'	45'
Horizontal discharge	250'	75'	125'
Size of discharge pipe	4"	4"	6"
Period of test	3 days	5 days	426 days
Fuel	Pick-up coal	Mine-run coal	Gasoline
Amount of fuel (gal. or lbs.)	760	1470	615
Water pumped (gals.)	47,620	125,093	4,836,000
Fuel per 1000 gals. water (gal. or lb.)	15.9	11.75	.13
Cost of fuel (gal. or ton)	$ .80	$ 1.80	$ .10
Wages of pumper per month	17.50	17 50	10.00
Cost ignitor battery per 1000 gal. water			.0011
Cost of waste and lubrication			
Cost of fuel per 1000 gal. water	.00638	.0106	.013
Cost of labor per 1000 gal. water	0362	.0229	.028
Total cost per 1000 gal. water	.04258	.0335	.0421

TABLE 2.—Cost of pumping water. C. & E. I. R. R.

A. W. Merrick, Chicago and North Western Railway:

"Here are two tables covering cost of pumping water by gasoline engine power. A part of the data in one of these tables has appeared before in a previous report to this Association, but as the information is well detailed and pertinent to this subject and in shape to be compared with later results, I thought it well to incorporate it here. The reports on the Chicago and North Western pumping stations have not appeared before in our proceedings."

COST OF PUMPING WATER PER 1000 GALLONS BY GASOLINE POWER (NOT INCLUDING REPAIRS).

	C. & N. W. Ry., 1903.			C. & E. I. R. R., 1899.		
	Richmond, Ill.	Normandy, Ill.	Buda, Ill.	Bourbon, Ill.	Clinton, Ill.	Wellington, Ill.
Kind of engine...........	3½ H.P. Otto	10 H. P. Otto	10 H. P. Otto	6 H. P. Otto	10 H. P. Otto	F. M. & C., 3 H. P. Comb.
Speed of engine.........	390 rev.	300 rev.	312 rev.	325 rev.	300 rev.	850 rev.
Kind of pump	5''x6'' Demming	16'' Strk. Curtis	16'' Strk. Curtis	5''x15'' Curtis	6''x18'' Curtis	Combinaton Eng. & Pump
Strokes per min	80	40	44	46	48	44
Size of suction............	8''	4''	4''	6''	6''	6''
Size of discharge	2½''	4''	4''	6''	6''	4'
Distance pump to tank ..	860'	50'	1600'	2600'	1000'	300'
Height pump to top of tank	44'	44'	44''	40'	63'	35'
Height pump above water	9'	8'	2'	10 to 25'	13'	10' to 25'
Time of test.	13 hrs. 15 min.	1 hr. 20 min.	2 hrs. 18 min.	6 hrs.	4 hrs.	131 hrs.
Total gal. pumped........	21,664	11,314	20,131	26,965	36,180	532,560
Gals. gasoline used				2.9	2.25	55.37
Pumper's wages..........	$ .36	$ .15	$ .26	$10.00 per mo.	$10.00 per mo.	$10.00 per mo.
Cost gasoline per 1000 gal. water...........	.0115	.0114	.0094	.01075	.00741	.01040
Cost labor per 1000 gal. water	.0166	.0133	.0129	.01196	.00960	.01088
Total cost per 1000 gal. water	.0281	.0247	.0223	.02271	.01710	.02128

TABLE 3.—Comparative cost of pumping water. C. & N. W. Ry. and C. & E. I. R. R.

AVERAGE COST OF PUMPING WATER PER 1000 GALLONS BY GASOLINE ENGINE POWER FOR SIX MONTHS, AUG., 1902, to JAN., 1903, INCLUSIVE (NOT INCLUDING REPAIRS).

C. & N. W. Ry.	Consumption under 500,000 Gallons per Month.		Consumption over 500,000 Gallons per month.	
Divisions.	Gallons per Month.	Cost per 1000 Gallons	Gallons per Month.	Cost per 1000 Gallons.
Galena	384,000	$ .0760	1,532,000	$ .0413
Wisconsin	196,000	.0500	989,000	.0303
Iowa.............			15,320,000	.0200
Ashland.........	107,000	.1130	2,034,000	.0306
I. & M	286,000	.0905	4,109,000	.0392
Average		$ .0824		$ .0323

TABLE 4.— Average cost of pumping water by gasoline power. C. & N. W. Ry.

"An important point to be taken up in connection with the matter of application of kerosene or alcohol to internal combustion engines is the method of starting. We have usually arranged for two tanks, one for gasoline and one for kerosene, and have started the engine in the usual way on gasoline; and then turned three-way cocks so that the gasoline is shut off and the kerosene turned on. We have found in arranging matters in this way that when the machine is thoroughly loaded the fuel consumption when operating on kerosene is about the same as on gasoline, with the addition of the amount of gasoline required to start; in other words, we have found that at the prevailing prices of the two fuels there is a saving of about 40% by the use of this system, which is sufficient to pay for the engine itself in a reasonable length of time.

"There is another method of starting and that is the use of a primus torch, which is used to heat the air as it is taken into the cylinder.

"We have a number of engines running at our plant at Beloit on kerosene and have furnished fixtures for quite a number of engines elsewhere. We prefer to furnish fixtures for an engine with a fairly set load, loaded to more than half the capacity of the engine.

"A great deal has been written on the subject of application of kerosene to gasoline engines in the *Gas & Power Magazine*, where some of our customers have cited their success with the appliance, and reference has also been made to this in tests made by the Reclamation Service Department and the Agriculture Department in looking up the matter of alcohol for engines."

Mr. Geo. H. Bremner, of the Chicago, Burlington and Quincy Railroad Company, in speaking of the relative cost and amount of gasoline and kerosene in gasoline engines, reports the result as follows: "We had one of our pumping engines at the water station at Shabbona, Illinois, equipped for this purpose. At this point we have a well 122 feet deep and also a large shallow one. About one third of the water is obtained from the shallow well. Sixty gallons of kerosene and sixty gallons of gasoline were tried. The kerosene cost 8¼ cents per gallon and the gasoline cost 15 cents per gallon. We pumped with the kerosene in the first test 196,216 gallons at a cost of $.0253 for fuel only per thousand gallons of water pumped. With the same amount of gasoline we pumped 270,640 gallons of water at an average cost of $.0332 for fuel only per thousand gallons of water pumped. There are, however, some objectionable features to the use of kerosene which offset the saving in fuel to some extent. One is that it is somewhat dirty, and another is that it requires closer attention on the part of the pump man."

As to the use of kerosene, Mr. P. Swenson, of the Minneapolis, St. Paul and Sault Ste. Marie Railway, has this statement to make:

"I have had a couple of engines with which I have used kerosene in the place of gasoline with very good success. The only change to make on a Fairbanks, Morse & Company's gasoline engine is to put in two tanks, one with kerosene and one with gasoline, as it is necessary to start the gasoline engine with gasoline and run it for about twenty minutes until the cylinder becomes heated, then turn off the gasoline and turn kerosene on, and the engine will run all day or as long as you desire on kerosene.

"In regard to the amount used. My experience is that we use a little less kerosene than gasoline. One must be particular about keeping the ignitor clean. It might have to be cleaned once a week. There is considerable saving in using kerosene, as kerosene can be purchased for about one-half the cost of gasoline. Next summer I will install a good many of these plants. I have been running one here at Shoreham Shops, Minneapolis, for six months, and have not spent one dollar for repairs. We have seventy-two gasoline engines on this system.

"In regard to drawbridge turning apparatus, I would recommend gasoline engines. We have a 12 H. P. gasoline engine turning the drawbridge over Red River at Oslo, Minn., in less than one minute; length of span is 244'-9" and total weight 468,000 lbs. It is a big saving in using gasoline engines for turning drawbridges, as they are always ready for use and incur no expense when they are not in service. Where one is using steam he has to keep steam on the boiler at all times to be prepared for boats coming at any minute."

From replies to circular sent out by the Committee asking for certain information on this subject, several reports have been received, which are given as follows:

J. S. Berry, Supt. B. and B., St. Louis Southwestern Railway Co.:

"Kerosene is not used as a fuel in the pumping stations under my supervision.

"We have a Fairbanks, Morse and Co's. 8 H. P. combination gasoline engine and pump, with geared base, which is pumping water for locomotives. This plant has a four-inch suction, eight feet long, and a four-inch discharge, 100-ft. horizontal with 30-ft. vertical dimensions. The portion of data given below referring to gasoline power-pumping was obtained in operating this outfit."

Cost of pumping water per 1,000 gallons, gasoline,	$0.17
Cost of pumping water per 1,000 gallons, coal,	0.0335
Cost of pumping water per 1,000 gallons, labor,	0.042
Cost of gasoline per gallon,	0.17
Cost of coal per ton,	2.90

TABLE 5.—Cost of pumping water, St. L. S. W. Ry.

A. F. Miller, Pennsylvania Lines West of Pittsburg:

"Herewith data on comparative costs of pumping water by steam and gasoline power. The gasoline outfit was supplied with a 5 H. P. engine, eight-inch piston, with eight-inch stroke, and the pump had a six-inch suction 6-ft. long with a 10-ft. lift on same, while the discharge was six inches reduced to five inches, having a length of 35-ft. horizontally and same vertically.

"The steam plant had a 10 x 7 x 10 Blake pump, with a six-inch suction reduced to five-inch, having a horizontal length of 70-ft. and a vertical length of 12-ft., together with a six-inch discharge reduced to four-inch, having a horizontal length of 50-ft. and vertical length of 36-ft.

Cost of pumping water per 1,000 gallons, gasoline,	$0.00625
Cost of pumping water per 1,000 gallons, kerosene,	Not used
Cost of pumping water per 1,000 gallons, coal,	0.0125
Cost of pumping water per 1,000 gallons, labor, gasoline,	0.02
Cost of pumping water per 1,000 gallons, labor, coal,	0.05
Cost of gasoline per gallon,	0.10
Cost of coal per ton,	2.50

TABLE 6.—Cost of pumping water, Penn. Lines W. of Pitts.

NOTE: The difference in cost of labor per thousand gallons of water between coal and gasoline is explained by Mr. Miller as caused by wages of pumper, the man using coal receiving $33.00 per month and the man using gasoline receiving $5.00 per month.

A. Anderson, L. S. and I. Ry. Co.:

TOTAL COST OF PUMPING FOR 1907.

	Whitefish Tank.	Slapneck Tank.
Labor pumping,	$117.08	$187.91
Keeping fire under tank,	49.26	57.00
Coal for fire under tank,	19.37	19.37
Gasoline,	53.61	45.93
Oil and waste,	4.62	6.26
Repairs to engine,	48.59	72.59
Repairs, buildings or tanks,	36.67	169.39
Cost of all labor and material,	$329.20	$558.45
No. gals. water pumped during year,	2,176,000	3,208,500
	$15\frac{1}{10}$c. per 1000 g.	$17\frac{4}{10}$c. per 1000 g.

TABLE 7.—Cost of pumping water, L. S. & I. Ry.

"The above statement is record kept of pumping and repair costs at two of our principal water stations for the year 1907, and represents a year's maintenance and operation. You will notice gasoline cost per thousand gallons of water is about $.0187. I am giving you the above information with the idea that perhaps there are other costs you would like to get at. We use only a 3½ H. P. gasoline engine at Whitefish and a 2½ H. P. at Slapneck. The pumps and engines are located beneath tank. We have fires there from about November 1st to April to keep engines, pumps and water from freezing. We use ordinary soft coal, with station stoves, for this purpose."

J. F. Parker, Atchison, Topeka and Santa Fe Railway:

"We do not use on this division either gasoline, kerosene or coal. We have three plants where distillate is used and at the balance of our pumping plants we use oil for fuel. I have given you the cost for one gas engine plant, also for one plant where crude oil is used for fuel. The deep well pump and power head used at the distillate plants is, I believe, machinery that is used only on this coast (the Pacific). If you desire I could give a further description of the pump and power head."

Cost of pumping water per 1,000 gallons, distillate,	$.039
Cost of pumping water per 1,000 gallons, labor,	.015
Cost of distillate per gallon,	.08

TABLE 8.—Cost of pumping water, A. T. & S. F. Ry.

Pomona deep well has a double plunger pump, with No. 18 power head, operated by 10 H. P. West Coast gasoline engine; 6-inch suction, 80-ft. lift; discharge is 4-inch, 600-ft. horizontal and 27-ft. vertical.

"Our pumping is done principally by steam, using crude oil for fuel at 25 cents per barrel of 42 gallons. With this oil we are enabled to raise water 80 feet. including suction and discharge, at a cost of $.0015 for the oil per thousand gallons of water pumped and $.015 for labor, or a total of $.0165. At this crude oil plant, Victorville, we produced for the month 3,507,000 gallons of water at a cost of $77.50 for fuel, labor and maintenance, or an average of $.022 per thousand gallons of water."

F. Ingalls, Northern Pacific Railway:

We have a 5 x 12 pump in steam plant and a 20 H. P. gasoline engine, with Smith-Vaile deep well pump, in gasoline plant; 6-inch suction, 800-ft. long, with 12-ft. lift, in steam plant; 8-inch suction, 18-ft. lift, in gasoline plant; 6-inch discharge, 100-ft. long, in steam plant; 6-inch discharge, 125-ft. long, in gasoline plant; 6-inch discharge, 32-ft. to bottom of tank in both plants, vertically.

Cost of pumping water per 1,000 gallons, gasoline,	$0.0333
Cost of pumping water per 1,000 gallons, coal,	0.02
Cost of pumping water per 1,000 gallons, labor, gas,	0.0225
Cost of pumping water per 1,000 gallons, labor, coal,	0.039
Cost of gasoline per gallon,	0.15
Cost of coal per ton (lignite coal used),	1.25

TABLE 9.—Cost of pumping water, Nor. Pac. Ry.

J. H. Markley, Toledo, Peoria & Western Railway:

"I have no pump run by kerosene power and now have but one run by gasoline. Our engine on the draw bridge is run by steam, sometimes using coal slack. When this cannot be obtained we use mine run coal. At times the draw is opened twelve to fifteen times in twenty-four hours; occasionally about five or six times in same number of hours, so it is almost impossible to get the amount of fuel and cost of same per twenty-four hours. Then too, since we have been running pumps and hoisting engines in connection with pier work, we often take coal that has been unloaded for the draw engine. What little information I have to offer you is absolutely correct.

One gallon of gasoline pumped 12,680 gallons of water at a cost for gasoline of $.009463 per thousand gallons. Gasoline cost us $.12. We pumped at this tank 893,940 gallons of water per month, the labor charge $.02517 per thousand gallons. The engine is a four horse power combination with a four-inch suction, sixteen-foot lift; discharge is four-inch, horizontally fifty-feet, and vertically thirty-two feet. To test the expense of pumping with mine-run coal as fuel, at one of our heaviest water stations, we found it figured at $.01464 per thousand gallons for fuel only, which cost us $1.50 per ton. At this station we have a Knowles pump, size 10 x 6 x 10, 4-inch suction and 4-inch discharge. We draw the water from a very large reservoir which is situated near the pump. The horizontal length of the discharge pipe is 4,300 feet and the vertical distance 100 feet. At this station we have no way of recording the number of gallons of water pumped each twenty-four hours, as tank is located too far from the pump house. When tank is full it is so indicated by an electric bell at the pump house. (Cost of gasoline pumping here is $.035. Does not give labor cost for coal pumping.)

In order to get the above information I had some men at work near the tank and had them record the gauge and weigh the amount of coal used.

J. N. Penwell, Lake Erie and Western Railroad:

"We have but few gasoline pumping stations. We have two small plants that are not considered in this report which are very expensive. My experience has been that if a small supply is required there is but little economy in gasoline outfits, but where a large supply is required we have found the gasoline economical. We have but four gasoline pumping stations and no kerosene plants."

Cost of pumping water per 1,000 gallons, gasoline,	$0.032
Cost of pumping water per 1,000 gallons, coal,	0.057
Cost of pumping water per 1,000 gallons, labor,	0.012
Cost of gasoline per gallon,	0.11
Cost of coal per ton,	2.50

TABLE 10.—Cost of pumping water, L. E. & W. Ry.

"Have a Fairbanks, Morse & Co., duplex 10 x 7 x 12, steam plant and a Fairbanks, Morse & Co. 8 x 12 gasoline plant; 6-inch suction, 15-ft. lift and a 6-inch discharge, 3,600-ft. long, horizontally and 50-ft. vertically."

A. S. Markley, Chicago and Eastern Illinois Railroad:

"My own experience confirms what Mr. Penwell says in regard to gasoline plants not being economical for small supply of water. Taking the monthly reports from four steam and three gasoline plants on the Chicago and Eastern Illinois Railroad for one month of the current year, I find steam is more economical for a small supply of water. Columns 1, 2, 3 and 4 are for the steam plants, and 5, 6 and 7 for the gasoline plants, as shown in following table:

	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7
Date test made ..	May, 1908	May, 1908	May, 1908	May, 1908	May, 1908	May, 1908	May, 1908
Labor pumpers per month......	$110.00	$45.00	$15.00	$22.50	$40.00	$45.00	$10.00
Boiler	Two 70 H. P.	Two 50 H. P.	20 H. P.	10 H. P.	None	None	None
Size of pump. ...	Two 20x12x12	Two 14x8½x12	12x36 deep well pump 7¾x36 working bbl.	6x5x10	8 H. P. gas. eng., 5¾x36 steam end	4 H. P. gas. eng., with 7x10 pump	6 H. P. gas. eng., with 4½x10 pump
Capacity per hr. gals............	100,000	40,000	8,000	7,500	6,600	6,500	6,600
Kind of well.... .	Open	Open	Tubular	Open	Tubular	Open	Open
Vertical suction..	16 ft.	18 ft.	70 ft.	20 ft.	70 ft.	14 ft.	12 ft.
Horizontal suct'n	40 ft.	220 ft.	None	110 ft.	None	20 ft.	15 ft.
Size of suction...	12 in.	6 in.	7¾ in.	4 in.	5¾ in.	4 in.	3 in.
Vertical disch'ge	72 ft.	93 ft.	42 ft.	40 ft.	50 ft.	36 ft.	28 ft.
Horizontal disch.	5,275 ft.	10,450 ft.	800 ft.	300 ft.	50 ft.	150 ft.	20 ft.
Size of discharge	8 in.	6 in.	6 in.	3 in.	6 in.	4 in.	3 in.
Coal used and gasoline.... ...	100 tons	50 tons	4 tons	8 tons	60 gals.	35 gals.	76 gals.
Gallons pumped.	22,022,596	2,432,204	263,944	981,331	203,034	257,176	218,562
Cost per 1000 gals. water, coal.....	.00454	.02055	.01515	.00815	......	......	......
Cost per 1000 gals. water, gasoline	......	......	......	......	.07328	.01565	.03946
Cost per 1000 gals. water, oil.......	.00008	.00041	.00109	.00090	.00374	.00279	.00242
Cost per 1000 gals. water, labor....	.00499	.01850	.05683	.02292	.19701	.17497	.04575
Cost per 1000 gals. water, total.....	.00956	.03946	.07307	.03197	.27403	.19341	.08763

TABLE 11.—Cost of pumping water. C. & E. I. R. R.

Intermittent water-softening appliance installed at these points, making double pumping necessary. The vertical suction given is for pumping into softener, there being no vertical suction when pumping into storage tanks against head. Softening tanks are set with bottom above or level with pump from which water is pumped into storage tank. Suction pipes from well to settling tank, and discharge 8-in. in size. Pumps are so connected that both can be utilized in filling softening tank or in filling storage tank if so desired. Size of steam pumps given is for steam, water and stroke in order named.

The above quantities were taken from pumpers' monthly reports in reference to fuel used, etc., which was the best information available. Size of pump, etc., taken from plants as they exist. No. 7 operated by agent; No. 3 and No. 4 pumper handled two stations; No. 1, day and night pumper.

Coal, $1.00 per ton; gasoline, 12 cents per gallon; labor unloading coal in bunker, 8 cents per ton.

"In this table the total cost of station shown in column 7 is lowered on account of the small salary paid the pumper, who acts as agent in addition to duties as pumper."

The table below gives number of gallons of water pumped per 100 pounds of coal, also amount of water pumped per gallon gasoline, together with average for each.

No.	Gallons Pumped.	Fuel Used	Gallons per Unit.	Average per Unit.
1	26,621,484	110 tons coal	12,100.6 to 100 lbs. coal	5,644.5
2	3,082,954	55 tons coal	2,802.6 to 100 lbs. coal	gallons
3	1,596,795	20 tons coal	3,991.9 to 100 lbs. coal	per 100 lbs.
4	653,093	9 tons coal	3,628.3 to 100 lbs coal	lbs. coal
5	274,096	116 gal. gas.	2,362.9 to 1 gal. gas.	2,755.6
6	314,703	100 gal. gas.	3,147.3 to 1 gal. gas.	gallons

TABLE 12.—Cost of pumping water, C. & E. I. Ry.

In summing up conclusions it may be said that our experience with kerosene in engines designed for gasoline is not yet broad enough to make any accurate statements concerning the economy of its use, although, in comparison with gasoline where both have been tried in the same plant, it is cheaper. Gasoline engines can be started instantly, while steam engines require more time to generate power. The data shows that gasoline is more economical where a small amount of water is furnished and where the pumper performs other work in connection with pumping. For quick and efficient service required on drawbridges, turntables, etc., where the engine is used intermittently, gasoline may be considered as the best motive power with the exception of electricity or air."

Committee {
A. S. MARKLEY, Chairman,
E. D. B. BROWN,
P. J. O'NEIL,
P. SWENSON,
A. W. MERRICK.

DISCUSSION.

Mr. Penwell.—We had quite a good deal of experience with gasoline engines for pumping water, and have learned some things that are quite different from what I have been told. I was told that a section man or a janitor or anyone else could handle them successfully, but have found that it requires a better man to run a gasoline engine than it does to handle a steam engine, from the fact that one cannot run a gasoline engine if there is the least part of the machinery out of repair. I have found also that for pumping water at both large and small plants, gasoline power is more expensive than steam. I am not favorable to gasoline engines. We have a janitor running one, but it is near my office and my chief clerk is somewhat of an expert on gasoline and steam engines and he looks after it about as much as the janitor does. We have but one gasoline engine which has been successfully and satisfactorily handled, and that is handled by a man who has nothing else to do but to look after this engine. If any have found the use of gasoline engines to be profitable, I would be glad to hear from them.

Mr. Hofecker.—I can heartily concur with Mr. Penwell. We have one gasoline engine on my territory and in keeping track of the expense as compared with a steam engine which was pumping more water, found that the cost of running the gasoline engine was just double that of running the steam engine, which was caused by the expense incurred in keeping the gasoline engine in repair. One of the principal difficulties which I have discovered in running this gasoline engine is the carbonizing of the cylinders causing short circuiting. That happens very frequently. This engine is kept running from one end of the month to the other. In my judgment it is a very poor arrangement for pumping water at the place where it is used.

Mr. Canty.—I am strongly in favor of the gasoline engine. We are obliged by the state authorities to have licensed men run steam plants, and have considerable bother in getting and keeping them for the price that the railroad company wishes to pay for their services. In steam plants the boiler flues are leaking frequently on account of the poor care of the men handling them. The gasoline outfits, however, are decidedly successful. We have several which are rated as high as 21 h. p. and pump 300,000 to 400,000 gallons in 24 hours. They give us practically no trouble for maintenance. We have a man to install these outfits who is an all round mechanic. When we put in a gasoline plant, he hires some one in the vicinity and instructs him in the proper manner of handling it. It may be due to this mechanic's good work that we are having no trouble. The statement can be made that the maintenance of gasoline pumping outfits is less expensive with us than steam plants, and the operation is more effective.

Mr. Alexander.—I can fully endorse what Mr. Canty has said about gasoline pumping outfits. We have many of them, and I am surprised to hear what has been said by Mr. Penwell regarding their inefficiency. In my experience they have proved quite economical, as we keep records of each plant. We have gasoline pumping engines from 4 to 25 h. p., three of the larger size and quite a number from 8 to 12 h. p. of the Fairbanks, Morse & Co. make. One man can take care of more plants than with steam, as the engine is ready to start at once and when shut down can be left at once. We also use the water which cools the cylinder by taking it into suction pipe. In steam plants we use the exhaust steam to warm water in winter with good results. I find where we use steam plants for pumping, if used every day, they will last two or three times as long as they will where they are used only one or two days each week; as the tubes in the boiler will rust out and the pump rods will corrode where they lay in the packing, so the repairs needed are much greater with steam plants than with gasoline where pumps are only run occasionally.

Mr. Spencer.—I have quite a few gasoline engines, of from 4 to 10 h. p., and we formerly tried to have our agents at the smaller stations do the pumping, and when we did that our engines were continually out of repair, and furthermore the water that we were trying to pump was costing us from 4½ to 5 cents per thousand gallons. After doing away with that system and putting on one man to look after several stations we reduced that cost to about 3½ cents without any further trouble. For heavy power where a large quantity of water is pumped, I think the steam plant is best, but for our smaller plants and where we can have one man to see to several plants, gasoline engines are best.

Mr. Gagnon.—On the subject of motive power for locomotive water supply stations, I wish to go on record as on the side of the gasoline engine, altogether and entirely, wherever it can be used. This for many reasons, but more especially as a matter of economy.

On our line (M. & St. L. R. R.), we have installed them from time to time for the last ten years, until now we have thirty gasoline pumping plants in actual operation, varying in capacity from a small two and one-half horse power engine used as auxiliary to wind mill pumping stations, to forty horse power engines in connection with air compressors to force water from great depths.

In my experience, whenever there is trouble, in nine cases out of ten, it is due to the men that handle the engines and not to the engine itself, the men being station agents or section foremen, of course it being taken for granted that the proper engine is selected for the work it has to perform and properly installed, the same as we do when we buy a steam pump.

Our standard is a six horse power gasoline engine with a larger and heavier friction gear than is generally furnished with a stock engine, and they are set up and connected by our own forces. Where the demand for water is heavy, requiring the running of the engine say sixteen to twenty-hours out of the twenty-four, with a long pull for the water, we have had to substitute ten horse power. All have given satisfaction.

For a number of years the average cost per thousand gallons of water pumped circled close around the five cent mark, and I do not believe the cost is very far from this today. Exceptionally well conditioned stations do not exceed two cents per thousand gallons.

I have in mind such a station where the same man has had charge since the gasoline engine was installed seven years ago. The engine is the one originally installed, six horse power. Water taken 120 feet from the surface through six-inch pipe. The first year the plant was in operation the average cost per thousand gallons was three and seven-tenths cents. The present average cost is a fair fraction less than two cents. The figures given cover gasoline, lubricating oils, waste, battery supplies, minor repair parts, salary of agent-pumper and pump repairer's time. The lower cost today is partly due to the man; he knows and cares for his engine and treats it properly; and the other factor entering into the saving at that station is a heavier traffic due to extension of the line, this causing more regular pumping with consequent less waste of gasoline, etc., and also lessening the cost in items of pumper and pump repairer expense.

Of course we have plants where the cost runs considerably above the figures given, but in no instance is this caused by inefficiency of the gasoline engine, but is due to unfavorable water supply conditions.

I have no data at hand to elaborate on this subject, and the factors of varied conditions are so many that it would be useless to try to give the subject justice in a short talk. As I have no desire to trespass on valuable time, I will only add that if the committee having this subject in hand is continued and believes the information will be of any use to it, I will gladly furnish such data as we have which will help to bring the matter to a clearer understanding at a future meeting of the Association. I am very much interested in this question of water supply and power used in obtaining it, especially the gasoline engine, and will be pleased to answer any communication from any member at any time on this subject.

Mr. P. Swenson.—In regard to gasoline engines and steam pumps and boilers, I think there is no question but that gasoline engines are cheaper to operate and take care of than steam pumps and boilers. I have charge of 2,400 miles of road and in my experience have found that the gasoline engines are by far the cheapest and less troublesome to take care of. For the last 18 months we have not had a water failure. Take, for example, if the water is bad, analyzes up to 70 or 80 grains of solid matter per gallon, one will find that it will eat the flues in three or four months, and as quickly as you get leaky flues you have to exchange boilers, which is a big expense. I had a steam plant put in at a place called Hankinson, where we had to change boilers every four months. We took out the steam pump and boiler and put in a gasoline engine three years ago, and have had practically no expense since, as gasoline engines are never affected by bad water. One of the secrets to success with gasoline engines is to put them on solid concrete foundations. We are using geared-base gasoline engines for pumping purposes; put them 16 feet from the well and install a 16 feet shaft and face plate. They can be connected either with deep well or shallow well pumps. I think if any member who has trouble with gasoline engines will put them on solid concrete foundations and take a little pains in instructing the men who have charge of them to see that they are properly taken care of, they will have no difficulty in running them; and, another thing, gasoline engines are always ready for use at any time, while steam pumps and boilers must be fired.

Mr. Burpee.—In regard to steam plants, I think the question of leaky flues may depend upon the material of which they are made. Steel has been much used in recent years, and has disappointed those who expected it to give better results than wrought iron.

In regard to corrosion of tubes, it may be that wrought iron, which usually is more satisfactory than steel in this particular feature, would be found all right.

Would it not be well for the Association to procure definite records of experience in this matter?

Mr. Ewart.—It seems to me that in this question of comparative values it makes quite a difference whether your coal is costing you $3.50 or $1.75 per ton. Our coal costs about $3.50. We have had very good results from gasoline and have taken out a number of steam plants and replaced them with gasoline plants for the very reason that it does not cost so much to pump the water. There has been something said about rusting in steam plants. We do not have a steam pump but what is composition fitted and with bronze piston rods; consequently we do not have any trouble on account of rust. The successful use of gasoline in a large measure depends on the man who runs the plant, but any man of ordinary ability with interest in his work ought to be able to master the kinks in any gasoline engine. On the whole, we have had very good success on the ground of economy and good service with gasoline. I do not believe much in using kerosene, as there is too much trouble from carbonizing.

President.—Is there any further discussion on this matter? If not, we will pass to the next subject.

VI.

MODERN DWELLING HOUSES FOR SECTION FOREMEN AND SECTION MEN IN OUTLYING DISTRICTS.

REPORT OF COMMITTEE.

To the Association of Railway Superintendents of Bridges and Buildings:

Your committee on "Modern Dwelling Houses for Section Foremen and Section Men in Outlying Districts" submits the following preliminary report:

At the suggestion of the President of our association the scope of this report is extended to include not only permanent houses for section men but portable houses as well. As much of the temporary and portable housing and caring for men is actually accomplished by using cars, your committee was directed by the President of this Association to include cars as a means of housing men in outlying districts.

Your committee held its first meeting in Chicago on March 18. It was decided to send out a circular letter to the various railways asking for copies of their standard or used plans for such structures as were within the scope of the studies of your committee. Such circular letter was sent and as a result forty-one different railroad companies responded most courteously and generously. (See list.) It is gratifying to your committee and should be a source of pride to this Association that its official appeals are heeded so generously.

The plans furnished us comprise section houses, section foreman's houses, section laborer's houses, agent's houses, watchmen's houses, bunk houses, such as permanent, temporary, knock-down, concrete, old tie houses and special houses for special races. The quality of house shown has a wide range. The diversions to suit wide variations in climate and adaptability to different nationalities of laborers are most marked. Some roads have one plan for the north and one for the south end of their line; one plan for the mountain and another for the desert plain. Clearly this general subject of housing men in railroad work is one which railroad officials are now studying as never before. No man can see the aggregate of plans sent your committee and consider these plans even casually without being compelled to form this opinion.

Your committee has found the subject given them to be so broad, the material forwarded to them for their studies so abundant and the time so short that they feel unable to make any final report. It deems it best to make this preliminary report upon a few points of a simple nature, trusting that discussion will ensue which will aid the committee in framing a final report. The recommendations we make are purposely chosen so as to be of

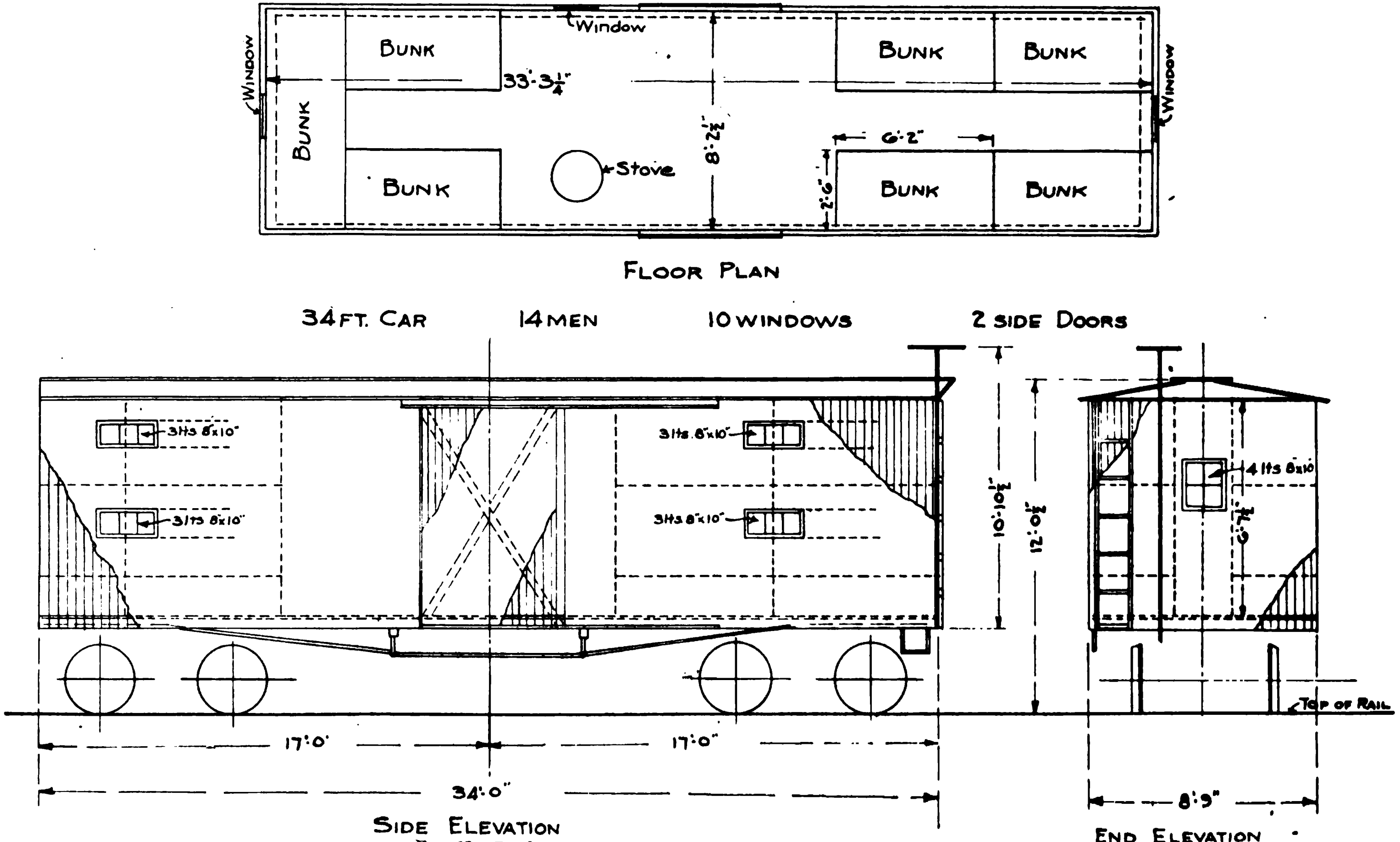


Fig. 19. Bunk Car for

general interest. They are the most common and of least cost. The names of the company using any type of housing men is purposely omitted from the drawings at this time. A complete list of the companies furnishing the plans will be found at the close of this report, together with a brief summary of the plans furnished by each company.

BUNK CARS FOR LABORERS.

This is a type suggested for a bunk car, Fig. 1, made by converting an ordinary 34-foot car at a moderate cost. It accommodates fourteen men in single bunks, arranged in two decks. There is a sliding window, protected by a screen, for each two bunks. The windows are merely fastened on the outside, without window frames. The only doors are the sliding freight doors of the original car. A caboose stove is provided. The car is for temporary or summer use, fitted up at a low cost to care for as many men in the usual car as most of our foreigners will be satisfied with. This car is not damaged by this method of fitting up. It is possible to remove the bunks and stove, take off the windows, patch the sides and roof and put the car back in freight service if desirable.

SLEEPING CAR FOR MECHANICS OR WHITE MEN.

We use the term sleeping car for a car intended for white men in use throughout the year and the term bunk car for a car used for foreigners, usually, and ordinarily in service during the summer working season of that climate.

Sleeping car, Fig. 2, was a passenger coach, having a body 55 feet long. The platforms remain and the windows and ventilators are still in the car. The particular car is for a bridge gang. It has beds for twenty-four men, an economical number for a bridge gang. The bunks are double on one side and single on the other side, and are in two decks. The bunks are for good-sized men. There is a commodious sitting room in one end, with wash sink and table, which is movable. There is a foreman's room in the other end of the car. This car has been used many years and is liked by the men. For this gang of twenty-five bridge men there is also furnished a second car, which is a cooking and dining car. A third car is a tool car, and, sometimes, a fourth car as a wash car, in which are lockers. This fourth car is especially needed where the sleeping car is a little shorter and thus gives but a small room to sit in. The car has coach trucks and air brake.

DINING AND COOK CAR.

This car, Fig. 3, is for a good-sized gang and for permanent use in a cold climate. While its use is not confined to mechanics, it is suitable for white men to use in any climate. Our foreign laborers use no dining car or are content with poorer cars than the one shown. But the economy of employing any labor who do not wish to use dining cars may well be questioned. The kitchen space in this car is of generous dimensions, a desirable feature. The store room is ample and in the middle of the car. This location is not the most common one, but has its strong points, particularly in a cold climate. The dining room seats about forty

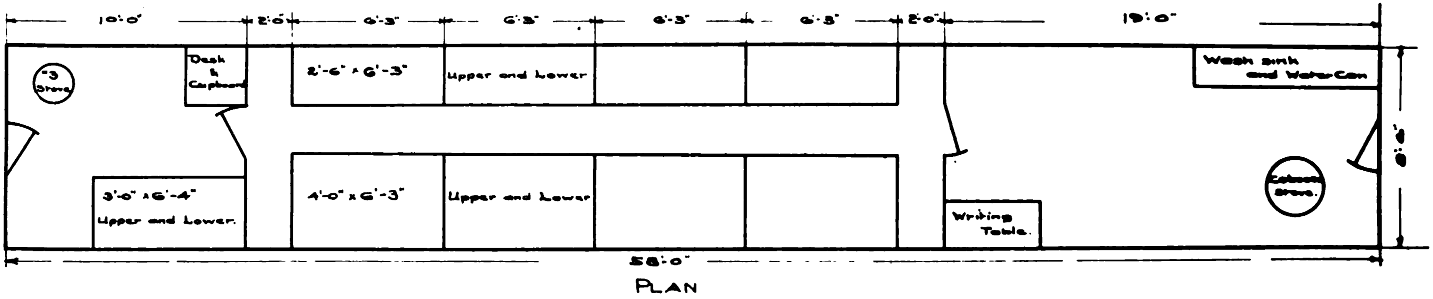
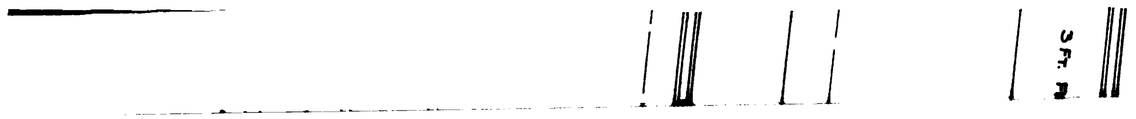
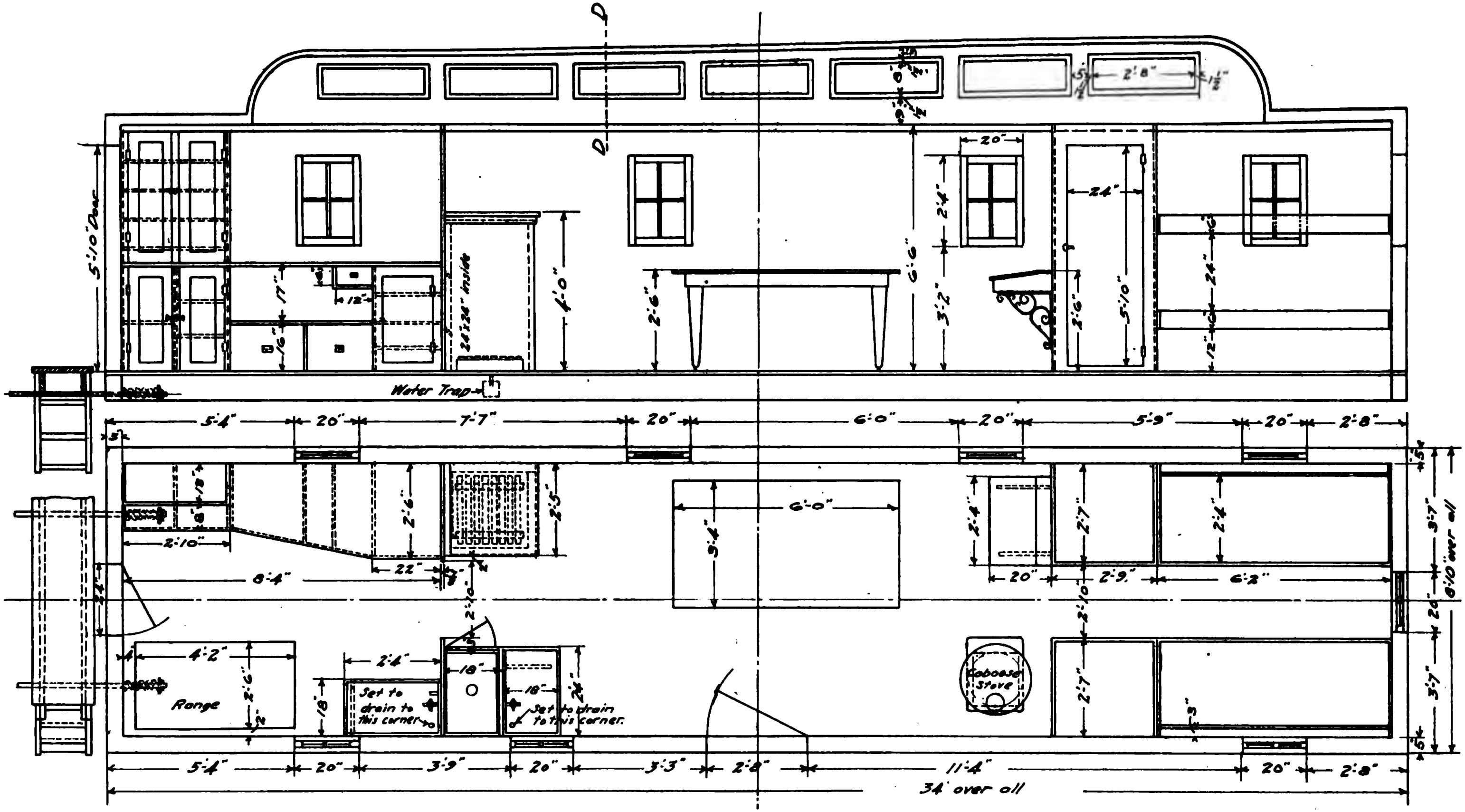


FIG. 20.—Sleeping Car for White Men, using a Passenger Car. L. S. & M. S. Ry.



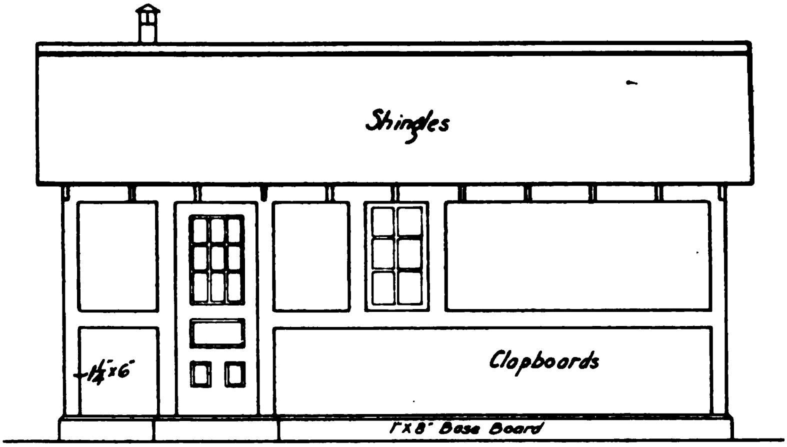
NOTE.—End and side windows to slide and have stops.

FIG. 22.—Combination Sleeping, Cooking and Dining Car for four men, using 34 ft. box car.

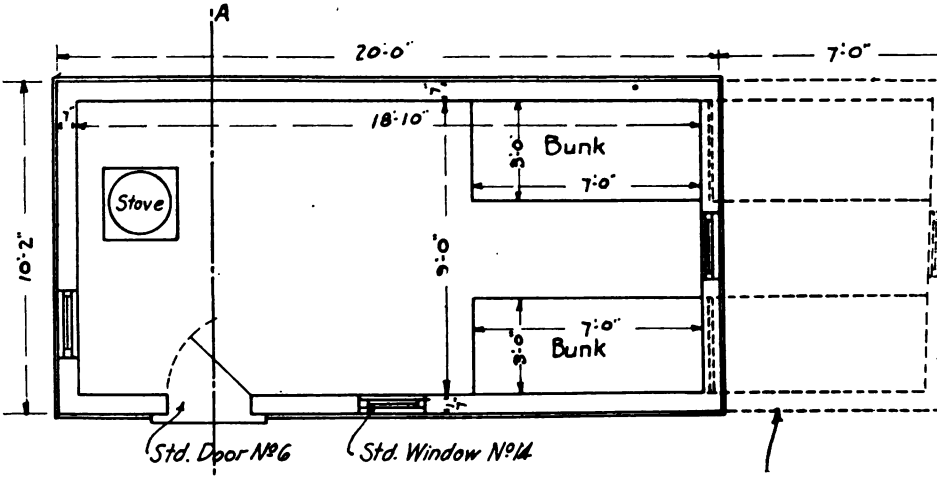


NOTE.—End and side windows to slide and have stops.

FIG. 22.—Combination Sleeping, Cooking and Dining Car for four men, using 34 ft. box car.

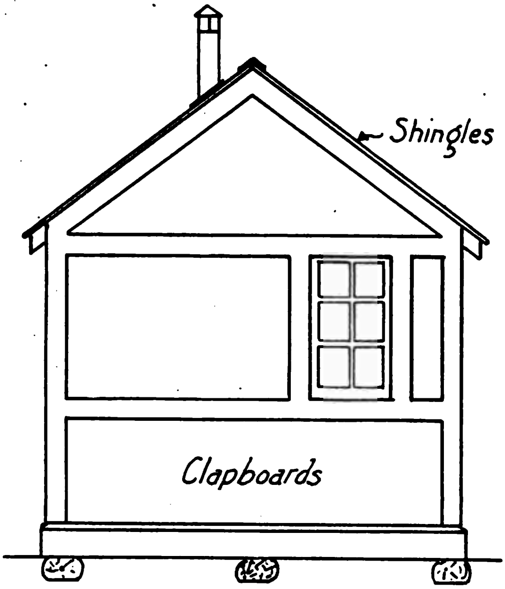


FRONT ELEVATION

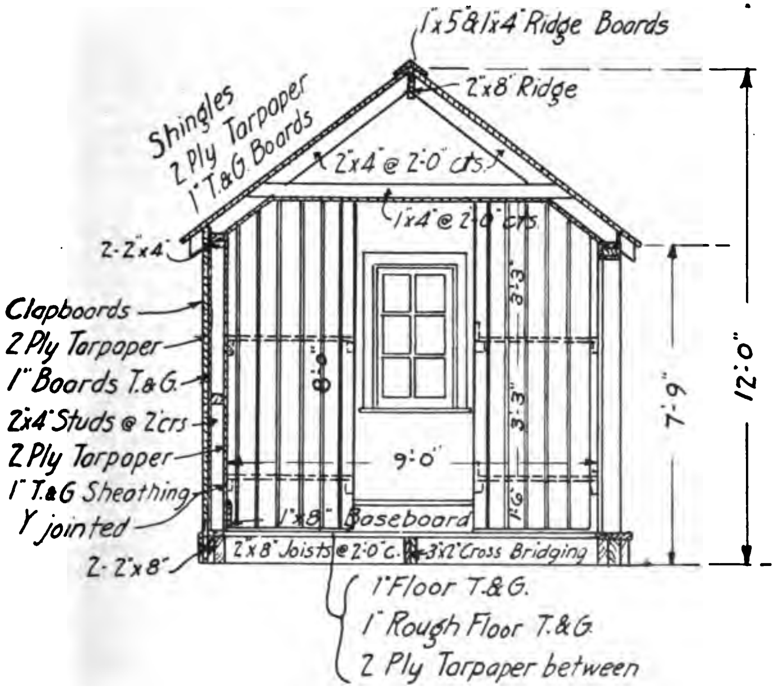


PLAN

FIG. 23.—Portable Bunk House. L. S. & M. S. Ry.



END ELEVATION



SECTION AB

FIG. 24.—Portable Bunk House. L. S. & M. S. Ry.

men. The seats are not as accessible and the men are seated in less space, on the whole, than in many other cars, especially those used in a hot climate. The car is excellent, of great capacity and shows good design.

COOKING, DINING AND SLEEPING CAR.

This is a gang car, Fig. 4, for a few men and is designed to take care of these men, but not of their tools. It is a car used by a maintenance gang of a signal department. There are four men who occupy the bunks; the cook has his folding cot. It is a converted 34-foot box car, with roof ventilators put in and one removable platform added. At the other end there stands the tool car of the gang. The two cars complete this outfit. The car has freight trucks and air brakes. The car is well fitted for constant service and for white men. The side view is drawn as seen when standing in the car looking outward. The bunks are single in width and in two decks. Two large lockers for the men's clothing are adjacent. A side desk for the foreman is shown. The table is movable. There is a good ice box as well as a coal box. The cooking range is a small one. There is but one end and one side door. This is found a good plan when there are but few men. The light and ventilation is excellent. The car has a maple floor on top of the usual car floor. It is ceiled on sides and top. All fittings are of dressed lumber and the car is thoroughly painted inside and outside in the standard colors of the road. It may be taken as the limit of fitting up of a good sound car for the permanent use of a small gang of white men, throughout every year.

PORTABLE BUNK HOUSE.

If by a portable bunk house we mean one that can be moved about from place to place on one railroad flat car, without taking that bunk house apart into two or more sections, then the plan submitted is the only plan of a portable bunk house sent your committee. This house is short enough in any case to load on one flat car. It is narrow enough for side clearance. It is low enough when on a flat car for overhead clearance.

Some roads call a house portable when it can be moved by taking it down in sections as those sections were built. Some roads call a house portable when built in their shops to be sent out on lines under construction, there to be put together, but never moved in future. A house that must be knocked down to move, or one built to be moved but once, seems to your committee hardly within the terms of a portable house. Sectional houses, or knock-down houses, we hope to consider in a later report.

This portable bunk house, Fig. 5, is for four men, but when built to the dotted lines as shown in the ground plan, it is for eight men. When built for four men it is 20 feet long and for eight men it is but 27 feet long. Its width, 10 feet, 2 inches, and its height to the ridge, 12 feet, all insure easy transportation and safe clearance. It is a building and not a shack, nor a box car ruin. It is not an eyesore and commands itself for neatness and efficiency. On sections where men cannot be hired locally and who therefore live at home, one of these houses can be placed to help out the section temporarily and to keep the track up economically. The bunks are six inches wider and longer than in cars. They are single and in two decks. This is a pioneer design and, in the judgment of your committee, a plan which merits consideration.

The cost in each case for the construction suggested in this preliminary report is not stated. This would vary widely for different companies and for different parts of our own country. The unit prices for material and labor would vitiate any estimate made for general use. The cost of the work considered is not great. The prime question is efficiency. It is a question of wisdom in planning as we now see our problem. Any old box car fixed up by anyone in any kind of way is generally so much money poorly spent. We need to house men in a business-like way and at economical cost, all things considered.

Committee {
WILLARD BEAHAN, *Chairman*,
W. A. MCGONAGLE,
C. H. BISS,
THOMAS S. LEAKE,
CHARLES CARR,
W. E. HARWIG.

LIST OF COMPANIES FURNISHING PLANS AND BRIEF STATEMENT OF PLANS FURNISHED.

A. T. & S. F. Ry., four section houses, five bunk houses.
A. C. Lines, two section houses.
Bangor & Aroostook, section house with specifications.
Baltimore & Ohio, two section houses, one bunk house.
Can. Pac. (Western Lines), two bunk cars, two cars.
Can. Pac. (Eastern Lines), two section houses, three bunk houses, nine cars.
C. & O., two section houses.
C. H. & D., section house and four cars.
C. & A., section house.
C. B. & Q. (lines west), two section houses.
C. & N. W., two section houses.
C. M. & St. P., section house, portable section house and bunk house.
C. R. I. & P., two section houses, three bunk houses.
C. St. P. M. & O., section house.
D. L. & W., three section houses.
D. & R. G., section house, bunk house.
D. S. S. & A., two section houses.
D. M. & N., section house, two cars.
Grand Trunk, four section houses, sleeping and dining cars.
Great Northern Ry., section houses, fourteen cars.
Ill. Central, section houses, bunk house, agents' dwelling.
Kan. City Sou., section houses, bunk house, location plan.
Intercolonial, section houses, bunk houses.
L. S. & M. S. Ry., section house, bunk house, eight cars.
Lehigh Valley, nine types of laborers' houses.

L. & N., section houses, dining car and bunk car.
Maine Central, section houses and combination car.
Mich. Central, section house, bunk house and bunk car.
M. & St. L., section houses.
M. K. & T., section houses and bunk houses.
N. Y. C. & St. L., section house and two small houses.
New Jersey Central, sleeping and dining car.
New York Central, section houses and several cars.
Penna. R. R. (west.), section and portable bunk house.
St. L. & S. F. Ry., two section houses.
Southern Ry., section and section foreman's house.
Texas & Pacific, various buildings.
Union Pacific (west), building, bunk and Jap house.
Union Pacific (east), building and bunk house.
Vermont Central, building.
Wisconsin Central, building.

DISCUSSION.

Mr. W. Beahan, chairman of the committee, gave a short talk bringing out the salient points of the report.

Mr. Canty.—In fitting up our crew cars we have found it expedient to make up the frame work of the bunks of standard pipe, using standard cast iron screw joint fittings. Uprights have flanges which are screwed on the floor. The springs are arranged with a bar of iron on each corner, which is bolted to the frame of the spring, having hooks which rest on horizontal pieces of the pipe frame work. We have never figured the comparative cost between this design and the wooden form of bunks. Pipe supports permit the circulation of air, are easily cleaned, kept free from vermin, etc., and present so many good points that we do not hesitate about using them.

Mr. Higgins then gave an extended explanation of the different types of houses used in the Panama district, stating that he would send plans and photographs to the committee to be included in their final report.

Mr. Canty.—On our road we generally have four cars in an outfit. The first is used for sleeping only; the second has dining room and kitchen, with bunk for cook; third is divided, half for lounging room for the men, the other half for a shop for inside work; the fourth car is for storage of heavy tools and the small supplies which are carried. On all our outfits we try to keep on hand a small amount of lumber, so that minor improvements may be made and repairs carried along without sending to stock yard and waiting two or three days for material to arrive. We find this a very convenient thing and would not think of sending out an outfit without having a fair assortment of lumber and hardware. The supply and lounging cars are box cars and the dining and sleeping cars are old coaches. We seldom have over sixteen men with an outfit.

Mr. J. H. Markley.—In our bridge gangs we have three cars. One of them is a sleeping car 36 feet long and accommodates eight men and the foreman. Eight feet of one end is partitioned off for a private room for the foreman, where he sleeps and does his writing. The second car is 57 feet long. Twenty-five feet of one end is used for tools and supplies; the other end is used for cooking and eating. Under the car is a very large cellar. This, too, is used, to carry tools and ropes. The third car is an ordinary flat, used for the purpose of carrying hand and timber cars and some extra one, two and three-inch lumber. The paint gang have one car, 36 feet long. One end is used to cook, eat and sleep in; the other end for supplies. In the center of the car is the foreman's private room. On the roof are large boxes, where the ladders, scaffold boards and ropes are kept. Under the car is a large cellar, where some of the supplies are stored.

The car used by the fence men is divided into two apartments, one for sleeping and one for cooking and eating. The bunks in this car and painters are three ties high. The cars are extra high and made so for the purpose. The bunk frames in painters and fence men's cars are all made of one-inch gas pipe. The fence men and two bridge gangs each have cooks paid by them. The men put in extra time enough to make up for the cooks' wages.

Mr. Canty.—We never send out an outfit without a regular cook. He does no other work and is supposed to be a man experienced in cooking. We find it does not pay to have one of the men cook and do other work outside the cars. The small amount of money that is gained by compelling the cook to help on outside work is lost many times over through ill feeling of the men. It is our desire to make everything as pleasant as possible for our crews, as we find that it is profitable.

Mr. Penwell.—Our bridge gangs have three cars. The first is a car which has the office of the foreman, with his desk at one end of the car and the men's bunks at the other end. The center of the car is used by the men as their loafing place. We find this a very profitable investment for the company, as the men will stay in their cars at night and be better men than if they went elsewhere. We also have a 34-foot car fitted up for tools and temporary shop. We do not furnish a cook for these men. They eat at restaurants, which works out all right, as we have convenient restaurants and moderate-priced hotels. Our carpenter outfits have a cook, who is taken from the gang. This is not very satisfactory, however.

Mr. Burpee.—The discussion of what we might call the human side of the question is very interesting, I believe, to every one of us, and I hope the committee's work will be extended over another year at least, so that we may reach conclusions on the question that will be up to date. I think the report and discussion show that every road has been going through a process of development in this matter, and that already a great improvement has been made from the time when almost any car which was no good elsewhere was made to serve as a boarding car for men. There is perhaps no more important class of car than the boarding car, and its design and fitting up is well worth the study of railroad officials. The men whom we wish to employ in bridge and building crews are well worthy all the thought and consideration given to them, and while economy must be studied, I think it is a great mistake to carry it to such an extent as to force our men into uncomfortable or inconvenient quarters. Nothing makes more for good work than good cheer.

Mr. Penwell.—I agree with the spirit of the discussion and especially with the remarks made by Mr. Burpee on the human side of the question, and I believe this is a good live subject for next year.

Mr. Beahan.—As the discussion seems to have ended I wish to call your attention again to the fact that this is a preliminary report, and I hope that you will continue the committee, as we have only just begun our subject. In this connection I would say that railroad companies generally, those of them who have given the matter much thought, have two or three sets of cars, that is, a two-car, three-car and four-car outfit. In the two-car outfit they have a 34-foot car for the men and another for the supplies. This is for small gangs. The three-car outfit is used for a few more men, has a cooking and dining car, a second car for sleeping, and a third for a tool car. In the four-car outfit we have a coach for sleeping, another coach for dining and cooking, a 34-foot box car for tools and a supply car, for which we use a flat car. On the L. S. & M. S. and some other roads there is a fifth car, not mentioned in the plans, which we call a wash car. It is used by the men as a smoking and lounging place. We have had such a car during the last year and a half. It is very noticeable in this connection that while white men use double bunks, foreigners never do. They want single bunks, although I have never been able to figure out the reasons for this. Men who eat in the cars will do about 20%—and some say 50%—more than those who eat outside the car. We are finding out that we have to put our men on wheels. Temporary construction gangs, ballasting men, track men and others are coming more and more to be housed on wheels. I think the time is almost here when we will stop using old box cars or even old coaches, but will build regular cars designed for the purpose for which they are intended, and, while they will probably be of the box car construction, they will be longer, wider and higher, and will be much better fitted for housing men. There is big money in generous expenditure for this purpose.

President.—I would recommend to the chairman of the Committee on Subjects the continuation of this subject to next year.

Mr. Alexander.—We find it necessary to have cars for our regular bridge and building repair crews. We have three regular bridge and building outfits, and, besides these, one for painters and one for masons. We find the best cars for this purpose are old passenger coaches or baggage cars, as they allow good ventilation and give plenty of room. By using a 50-foot car for sleeping car, sitting room and tool room, with closets for clothing in one end, it will accommodate 12 to 16 men comfortably. For another a 40-foot car fitted for store room, cook room and dining room answers very well; also one box car for tools and repair room, and one flat car to carry lumber to and from small repair jobs. This comprises a complete outfit which gives general satisfaction. In some of our outfits we have women cooks, the woman's husband working in the crew and rendering what assistance his wife may need about getting wood, water, etc.

The question has arisen here as to the best method of setting off work cars along the main line. This may be done in various ways, but where it is hard to get right to break track, a good method is to use a derailing frog on one rail, with one switch point on the opposite side. The lead rail from switch point where it crosses the main rail to have the lower flange and web cut out so the ball of rail will cross on top of main line rail, being shimmed up to that elevation on the main line ties, the siding rails being laid to connect.

Switch points and derail frogs may be carried with outfit if they are needed frequently. With us the cases are exceptional where we would need to use this method with outfit cars, but with air compressor car at bridges it is very convenient.

VII.

*REINFORCED CONCRETE CULVERTS.

REPORT OF COMMITTEE NO. 7 TO THE ASSOCIATION OF RAILWAY SUPERINTENDENTS BRIDGES AND BUILDINGS.

Your Committee, in considering the subject assigned to it, thought it wise to present a report on the practical side of reinforced concrete culverts at this time, assuming that if it were considered necessary the theory of the subject would be referred to a future committee.

As short span bridges have been built with rails and I-beams for a number of years, it was considered unnecessary to make any report on these types of culverts, especially since reinforced concrete is of cheaper construction and has replaced almost entirely this older form of construction.

In gathering material for this report, the Committee found that Mr. C. F. Loweth, Engineer and Superintendent Bridges and Buildings of the C. M. & St. P. Ry. Co., had gone into the matter of construction of reinforced concrete culverts and short span bridges in a very thorough manner in connection with a large amount of work carried on under his supervision. Under his instructions a very extensive report was furnished the Committee by Mr. J. H. Pryor, an assistant engineer in his department. To these two gentlemen the Committee is entirely indebted for the information which is presented.

Types of culverts under consideration are shown on accompanying illustrations under sketches 1, 2, 3 and 4 of Fig. 25. Sketch 1 shows a reinforced flat top culvert, with side walls and foundations of plain concrete. Sketch 2 shows culverts with flat tops, side walls and foundations of reinforced concrete. Sketch 3 shows a reinforced concrete semi-circular arch. Sketch 4 shows a reinforced concrete three centered arch. Sketches are also presented, Fig. 26, showing a general method for forms for flat top and arch culverts. As examples of this kind of construction, illustrations are given to show reinforced concrete culverts of these four types with a clear span of 8 feet and a clear height of approximately 6 feet, Figs. 29–35. In order to emphasize the necessity for proper reinforcing at joints large detailed sketches are shown of the bar reinforcement at such places. (See Fig. 27.)

As all these types of culverts have been proven efficient and economical for railroad structures, the question to determine is, which type is the cheapest. To illustrate this there is shown a

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* We are indebted to the *Railway and Engineering Review*, Chicago, Ill., for use of cuts appearing in this report.

table (No. 12), giving quantities of material and costs per lineal foot for various sizes of culverts of these four types, and in order to show these costs at a glance, curves are given, showing the cost per lineal foot of the various types of culverts for different areas of waterway.

The tabulated costs for the steel, concrete and forms presented in these tables are based upon the following unit prices:

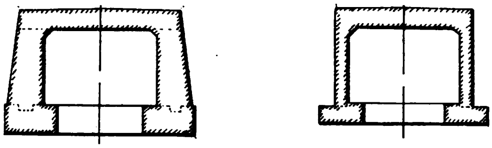
4 cents. per pound for reinforcing steel.
6½ cents per foot B. M. lumber for arch centers and lagging.
4½ cents per foot B. M. lumber for all other form work.
(Above prices include cost of material and labor on same.)
$5.00 per cubic yard of concrete for plain footings, benchwalls and abutments.
$6.50 per cubic yard for covers and reinforced and solid footings.
$8.00 per cubic yard for thin side walls and arch rings.
(Above prices for concrete include cost of material, labor of placing, excavation, etc.)

These prices are only relative, and will vary with numerous circumstances. The reader will probably have figures to suggest more nearly in line with conditions as he finds them. But the quantities are all given and new costs can be worked out for any other prices that may be chosen. Different prices per cubic yard of concrete are given to different parts of the section, in order that the final comparison of cost will take into account the constructive difficulties which make certain classes of work more expensive than others. Of course it would be impossible to say just what part of the total cost could be charged up for any one part of the structure, because most items of expense are charged to the completed job. It is obvious, however, that the concrete in thin walls, or where there is considerable reinforcement to interfere, will cost more to place than concrete in large masses.

The price per pound of steel is high enough to include the cost of cutting, bending and placing.

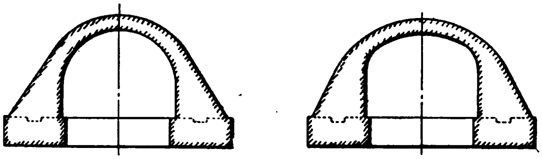
The prices for forms are based on a first cost of 2½ cents for material, which will be used twice, making the actual cost 1¼ cents per foot B. M. for one job. Labor is figured at 3¼ cents per foot B. M. for ordinary work, and 5¼ cents per foot B. M. for arch centers.

The figures in the table show that type "B" culverts are the cheapest, that type "A" culverts have the highest cost and that the arch culverts come in between. The average saving of type "B" over type "A" is about 16%. The saving of semi-circular arches, type "C" over type "A", is 13% for high fill and 4% for low fill. The saving of arches "D" for the low fill averages 2%. The reinforced type "B" box culverts are 5% cheaper than the type "C" arches under the high fill and 8% under the low fill, and 9% cheaper than type "D" under the low fill. The semicircular type "C" arches are 3% cheaper than the three centered arches, type "D." The double 10 feet x 10 feet culverts show a saving over the single 20 feet x 20 feet culverts of 12% for type



TYPE "A" BOX CULVERT.
SKETCH -1-

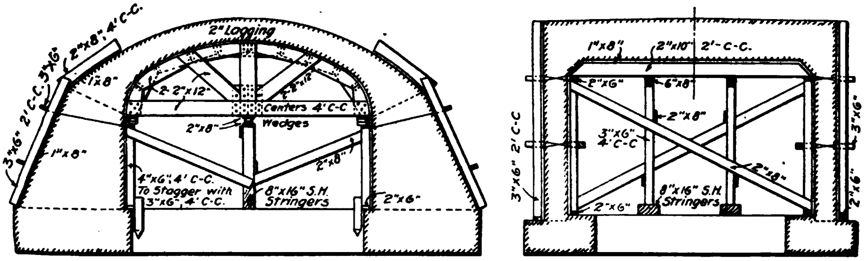
TYPE "B" BOX CULVERT.
SKETCH-2-



TYPE "C" ARCH CULVERT. (SEMI-CIRCULAR)
SKETCH -3-

TYPE "D" ARCH CULVERT (3 CENTERED)
SKETCH -4-

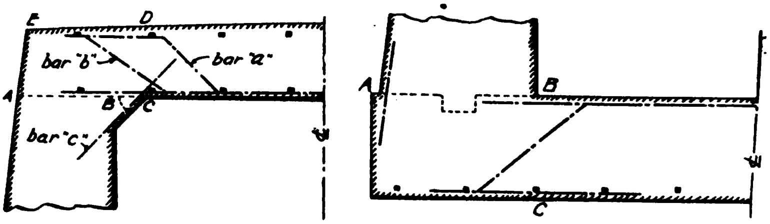
FIG. 25.—Types of Box and Arch Culverts.



FORMS FOR ARCH CULVERT.

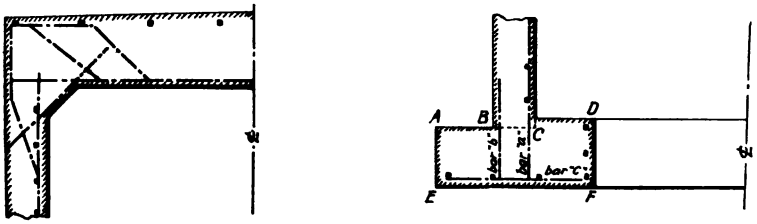
FORMS FOR BOX CULVERT.

FIG. 26.—Forms for Box and Arch Culvert Construction.



CORNER TYPE "A" SECTION.
SKETCH -5-

FOOTING TYPE "A" SECTION.
SKETCH-6-



CORNER TYPE "B" SECTION.
SKETCH-7-

FOOTING TYPE "B" SECTION
SKETCH-8-

Fig. 27.—Method of Reinforcing Corners in Culvert Construction.

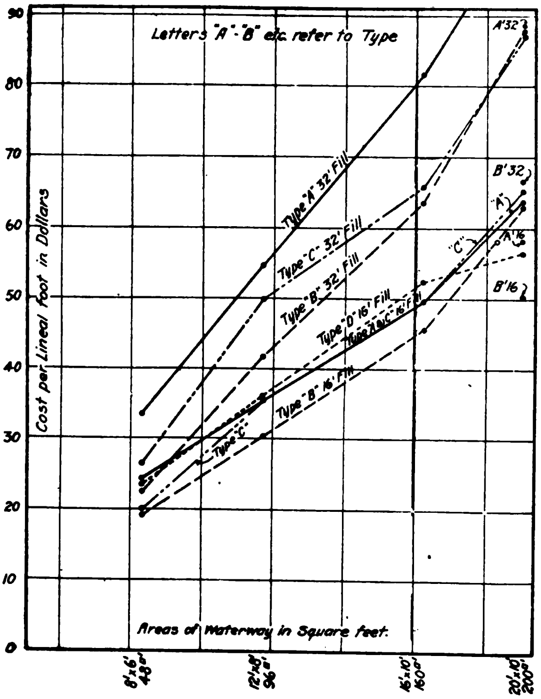
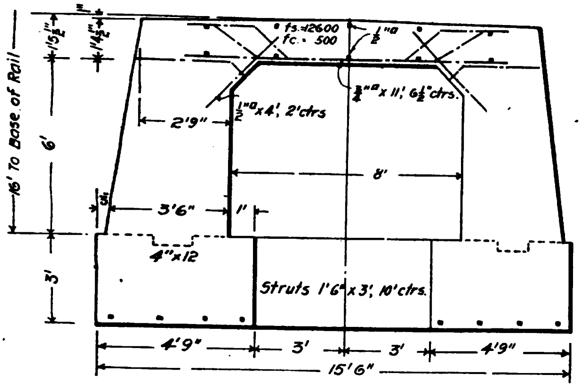


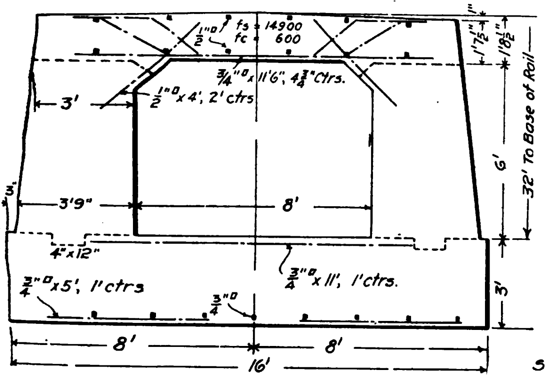
Fig. 28.—Curves of Cost per Lineal Foot for Culverts of Various Types and for Different Waterway Areas.



TYPE "A" 8'x6' 16' FILL			
		Am't	Cost
Concrete	Cover	.71 cu yd	$ 4.6
	Wall	1.39 "	7.0
	Foot	1.16 "	5.8
	Total	3.26 "	17.4
Steel	Trans.	4.93 #	
	Long.	15.3 #	
	Total	64.6 #	2.6
Forms		100 B.M.	4.5
Total Cost per Lineal Foot			$24.5

STANDARD 8'x6' CULVERT.

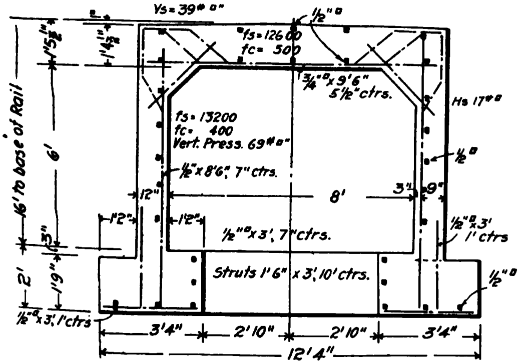
FIG. 29.—Type "A," Box Culvert for 16 ft. Fill.



TYPE "A" 8'x6' 32' FILL			
		Am't	Cost
Concrete	Cover	.87 cu yd	$5.7
	Wall	1.50 "	7.5
	Foot	1.78 "	11.6
	Total	4.15 "	24.8
Steel	Trans.	98.8 #	
	Long.	27.4 #	
	Total	126.2 #	5.0
Forms			4.0
Total Cost per Lineal Foot			$33.8

STANDARD 8'x6' CULVERT.

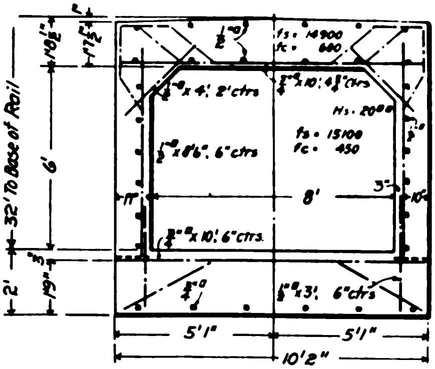
FIG. 30.—Type "A," Box Culvert for 32 ft. Fill.



TYPE "B" 8'x6' 16' FILL			
		Am't	Cost
Concrete	Cover	.53 Cu yd	$3.4
	Wall	.47 "	3.5
	Foot	.55 "	3.6
	Total	1.55 "	
Steel	Trans.	83.8 #	
	Long.	25.5 #	
	Total	109.3 #	4.4
Forms		100 B.M.	4.5
Total Cost per Lineal Foot			$19.4

8'X6' CULVERT (REINFORCED WALLS)

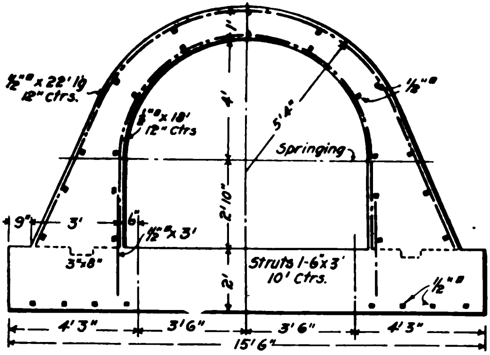
FIG. 31.—Type "B," Box Culvert for 16 ft. Fill.



TYPE "B" 8'x6' 32' FILL			
		Am't	Cost
Concrete	Cover	.63 cu yd	$ 4.1
	Wall	.51 "	3.8
	Foot	.76 "	4.9
	Total	1.90 "	12.8
Steel	Trans.	134.2 #	
	Long.	21.7 #	
	Total	155.9 #	6.2
Forms		90 B.M.	4.0
Total Cost per Lineal Foot			$23.0

8'x6" CULVERT (REINFORCED WALL)

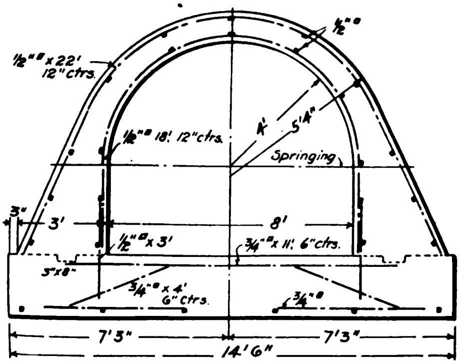
FIG. 32.— Type "B," Box Culvert for 32 ft. Fill.



TYPE "C" 48"' 16' FILL			
		Am't	Cost
Concrete	Cover	.65 cu yd.	$ 4.9
	Wall	.50 "	2.5
	Foot	.75 "	3.8
	Total	1.90 "	11.2
Steel	Trans.	39.1 #	
	Long.	25.5 #	
	Total	64.6 #	2.6
Forms		110. B.M.	6.1
Total Cost per Lineal Foot.			$19.9

ARCH under 16' Fill above Footing.
Bearing on Soil 1.9 Tons per sq. ft.

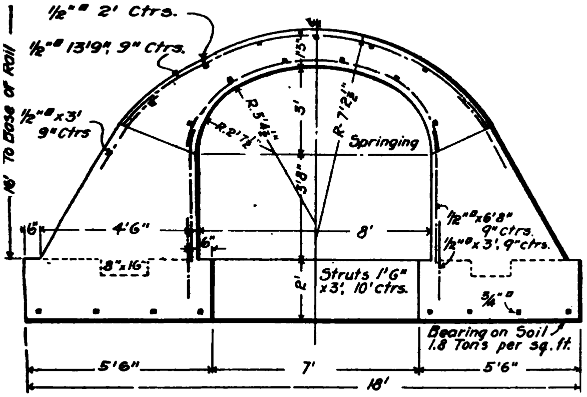
FIG. 33.—Type "C," Arch Culvert for 16 ft. Fill.



TYPE "C" 8'X6' 32' FILL			
		Am't	Cost
Concrete	Cover	.68 cu yd	$ 5.1
	Wall	.50 "	2.5
	Foot	1.07 "	7.0
	Total	2.25 "	14.6
Steel	Trans.	111.7 #	
	Long.	30.1 #	
	Total	141.8 #	5.7
Forms		105 B.M.	5.8
Total cost per Lineal Foot			$26.1

ARCH under 32' Fill above Footing.
Bearing on Soil 1.8 Tons per sq. ft.

FIG. 34.—Type "C," Arch Culvert for 32 ft. Fill.



TYPE "D" 48▫' 16' FILL		Am't	Cost
Concrete	Cover	.78 cu.yd	$5.9
	Wall	.96 "	4.8
	Foot	.90 "	4.5
	Total	2.64 "	15.2
Steel	Trans	50.0 #	
	Long	26.3 #	
	Total	76.3 #	3.1
Forms		105 B.M.	5.6
Total Cost per Lineal Foot			$23.9

FIG. 35.—Type "D," Arch Culvert for 16 ft. Fill.

QUANTITIES & COSTS PER LINEAL FOOT, FOR VARIOUS SIZES & TYPES OF CULVERTS

Size Area of Waterway	Type	Description	Fill above Top of Footing	Volume of Concrete in Cubic Yards				Weight of Steel in Pounds			Form Lumber in Ft. B. M.		Cost for Concrete in Dollars				Cost for Steel in Dollars	Cost for Concrete & Steel	Cost for Form Work Lumber & Labor	Total Cost per Lineal Foot in Dollars	Type
				Cover or Arch Ring above Springing	Side Wall or Abutment	Footing and Struts	Total	Transverse in Section	Longitudinal in Culvert	Total	Arch Segments & beveled lagging	Total	Cover or Arch Ring	Side Wall or Abutment	Footing & Struts	Total					
20'x 13' Highway	A	Rectangular	21'	3.15	3.86	1.73	8.74	26.64	68.9	334.3		230	20.4	19.3	11.2	50.9	13.4	64.3	10.4	74.7	A
	B			2.85	1.82	1.59	6.26	377.6	89.9	467.5		230	18.5	13.6	10.4	42.5	18.7	61.2	10.4	71.6	B
		Arched Cover		2.13	6.30	3.00	11.43	168.0	22.9	190.9	120	280	16.0	31.5	15.0	62.5	7.6	70.1	15.0	85.1	
20'x 10' 200▫' Area	A	Rectangular	16'	3.19	2.52	1.80	7.51	253.0	65.0	318.0		190	20.6	12.6	9.0	42.2	12.7	54.9	8.6	63.5	A
	A'	Double 10'x10'		1.96	3.63	2.04	7.63	136.8	47.0	183.8		220	12.7	18.2	10.2	41.1	7.4	48.5	9.9	58.4	A'
	B	Rectangular		2.80	1.07	1.72	5.59	328.0	96.0	424.0		190	18.2	8.0	11.2	37.4	17.0	54.4	8.6	63.0	B
	B'	Double 10'x10'		1.70	1.59	.89	4.18	212.1	71.9	284.0		220	11.1	11.9	5.8	28.8	11.4	40.2	9.9	50.1	B'
	C	Full Cen. Arch		3.09	.74	2.22	6.05	152.0	54.7	206.7	160	275	25.2	3.7	14.4	41.3	8.3	49.6	15.6	65.2	C
	D	3 " "		1.95	2.30	2.30	6.55	88.9	56.0	144.9	135	230	14.6	11.5	11.5	37.6	5.8	43.4	13.1	56.5	D
20'x 10' 200▫' Area	A	Rectangular	32'	4.10	3.61	3.50	11.21	659.1	76.9	736.0		180	26.6	18.0	22.8	67.4	29.4	96.8	8.1	104.9	A
	A'	Double 10'x10'		2.33	4.72	3.84	10.89	305.9	71.4	377.3		205	15.2	23.6	25.0	63.8	15.1	78.9	9.2	88.1	A'
	B	Rectangular		3.40	1.20	3.22	7.82	596.0	92.2	688.2		180	22.1	9.0	20.9	52.0	27.5	79.5	8.1	87.6	B
	B'	Double 10'x10'		1.91	7.80	1.84	5.55	406.0	73.9	479.9		205	12.4	13.5	12.0	37.9	19.2	57.1	9.2	66.3	B'
	C	Full Centered Arch		3.14	.14	3.56	1.44	456.2	77.3	533.5	160	265	23.6	3.7	23.2	50.5	21.4	71.9	15.1	87.0	C
16'x 10' 160▫' Area	A	Rectangular	16'	2.09	2.50	1.55	6.14	156.5	37.4	193.9		170	13.6	12.5	7.8	33.9	7.7	41.6	7.7	49.3	A
	B	"		1.85	1.09	.94	3.88	229.3	58.2	287.5		170	12.0	8.2	6.1	26.3	11.5	37.8	7.7	45.5	B
	C	Full Centered Arch		2.10	1.37	1.90	5.37	82.2	42.9	125.1	120	215	15.8	6.9	9.5	32.2	5.0	37.2	12.7	49.5	C
	D	3 " "		1.92	2.47	1.97	6.36	83.1	33.1	116.2	95	200	14.4	12.4	9.9	36.7	4.7	41.4	10.9	52.3	D
16'x 10' 160▫' Area	A	Rectangular	32'	2.74	3.61	3.06	9.41	419.9	58.0	477.9		155	17.8	18.1	19.9	55.8	19.1	74.9	7.0	81.9	A
	B	"		2.08	1.20	2.11	5.39	433.1	69.9	503.0		155	13.5	9.0	13.7	36.2	20.1	56.3	7.0	63.3	B
	C	Full Centered Arch		1.94	1.34	3.16	6.44	244.6	59.3	303.9	120	210	14.6	6.7	20.6	41.9	12.1	54.0	11.9	65.9	C
12'x 8' 96▫' Area	A	Rectangular	16'	1.30	1.95	1.35	4.60	89.4	20.4	109.8		140	8.4	9.8	6.8	25.0	4.4	29.4	6.3	35.7	A
	B	"		1.08	0.72	0.73	2.53	143.6	37.4	181.0		140	7.0	5.4	4.8	17.2	7.2	24.4	6.3	30.7	B
	C	Full Centered Arch		1.14	1.06	1.63	3.83	67.2	36.9	104.1	90	170	8.6	5.3	8.2	22.1	4.2	26.3	9.5	35.8	C
	D	3 " "		1.04	1.54	1.62	4.20	62.2	26.4	88.6	75	165	7.8	7.7	8.1	23.6	3.6	27.2	8.9	36.1	D
12'x 8' 96▫' Area	A	Rectangular	32'	1.65	2.40	2.39	6.44	226.3	34.6	260.9		130	10.7	12.0	16.5	38.2	10.4	48.6	5.9	54.5	A
	B	"		1.29	0.81	1.33	3.43	269.3	46.3	315.6		130	8.4	6.1	8.6	23.1	12.6	35.7	5.9	41.6	B
	C	Full Centered Arch		1.26	1.03	2.67	4.96	176.9	43.1	220.0	85	165	9.5	5.2	17.3	32.0	8.8	40.8	9.1	49.9	C
8'x 6' 48▫' Area	A	Rectangular	16'	.71	1.39	1.16	3.26	49.3	15.3	64.6		100	4.6	7.0	5.8	17.4	2.6	20.0	4.5	24.5	A
	B	"		.53	.47	.55	1.55	83.8	25.5	109.3		100	3.4	3.5	3.6	10.5	4.4	14.9	4.5	19.4	B
	C	Full Centered Arch		65	.50	.75	1.90	397	25.5	64.6	55	110	4.9	2.5	3.8	11.2	2.6	13.8	6.1	19.9	C
	D	3 " "		78	.96	.90	2.64	50.0	26.3	76.3	45	105	5.9	4.8	4.5	15.2	3.1	18.5	5.6	23.9	D
8'x 6' 48▫' Area	A	Rectangular	32'	.87	1.50	1.78	4.15	98.8	27.4	126.2		90	5.7	7.5	11.6	24.8	5.0	29.8	4.0	33.8	A
	B	"		.63	.51	.76	1.90	134.2	21.7	155.9		90	4.1	3.8	4.9	12.8	6.2	19.0	4.0	23.0	B
	C	Full Centered Arch		.68	.50	1.07	2.25	111.7	30.1	141.8	55	105	5.1	2.5	7.0	14.6	5.7	20.3	5.8	26.1	C

TABLE 12.—Showing Quantities and Costs per Lineal foot, for Various Sizes and Types of Culverts.

Type "A" refers to section with heavy, plain concrete bench walls.

Type "B" refers to rectangular section with thin reinforced side walls.

Type "C" refers to arch section with semi-circular intrados.

Type "D" refers to arch section with flat three-centered intrados.

NOTES ON COSTS.

The costs per cubic yard of concrete to include everything but steel and form work, were taken as follows: $5.00 for plain concrete footings, bench walls and abutments; $6.50 for covers and reinforced and solid footings; $8.00 for thin side walls and arch rings. Steel was estimated at 4 cents per pound in plan; form lumber for arch centers and beveled lagging, was estimated at 6½ cents, and for all other work at 4½ cents per foot, B. M. These figures to include cost of labor and material.

"A," and 22% for type "D." The double type "B" is 20% cheaper than the double type "A."

Curves drawn to show cost in the different sizes of culverts for the types adopted and fills shown give a little more information regarding the relative economy of the sections. It is to be seen that the per cent. of saving of the reinforced box culvert over the type with plain concrete walls is greater for small sizes and for any one size it is greater for the high fill. The arches compare most favorably with the box culverts where they come under a high fill and are of large size. The cost of an arch culvert is as low as that of the most economical box culvert for a span of 20 feet or more. The semi-circular arches are cheaper than the flat arches for small spans, but for large spans the flat arches have the advantage.

If it is assumed that the various culvert sections discussed are of equal strength, and that all differences in constructive details have been accounted for in the estimates of cost, then the foregoing figures and deductions give authority for a number of statements regarding the relative economy of the alternative types. While these may be fairly made from the data presented, still they exclude the consideration of any special conditions not appearing in this discussion and are therefore subject to numerous minor qualifications and exceptions.

1. The rectangular sections which make the most use of reinforcement are the most economical.
2. Arch sections for culverts are more economical than rectangular sections for large spans and less economical for average sizes.
3. Semi-circular arches are more economical than flat arches for spans under twenty feet.
4. Double culverts for large sizes are cheaper than single culverts.

Aside from the data upon which they were based, there are other good reasons for the above statements:

(a) Reinforced concrete proves more economical than plain concrete in almost every kind of structure which can be built of this material, and there are no distinctive features about culverts to make them an exception.

(b) The arch rings were designed as if of plain concrete and the reinforcement was not made much use of, therefore the arches are no cheaper than box culverts for small sizes. For spans of 20 feet and over the arches become cheaper, due to the mechanics of the problem.

(c) The comparison of high and flat arches is difficult, due to the arbitrary way in which they are designed. It would seem, however, that the flat arches with high, thick abutments ought to be more expensive. When the spans are long, however, and the greatest part of the material is in the arch ring, the flat arches may be cheaper.

(d) As the cover thickness varies about as the square of the span, the use of the two spans instead of one will save material.

In the matter of strength, the two types of box culverts which we are considering should be equivalent, since they have been designed by rational methods to take the same loads with the same factors of safety. Judging only from appearances the heavy section in Sketch 1 would seem to have the advantage over the section in Sketch 2 in the matter of stability. The type "B" section, however, is so thoroughly tied together by reinforcement that it would probably be less liable to distortion, due to unequal settlement, than the type "A" culvert. The thin thoroughly reinforced footings of the former will carry the load over holes and soft spots as well as deeper footings would, and if they are too shallow to find a good bearing, they can be dropped as deep as necessary, allowing the stream to fill up to its usual level. The arch culverts have the advantage over rectangular types in regard to both strength and stability. They have the material more advantageously placed; they tend to adjust themselves to the load which comes upon them, and they make use of the lateral thrust of the earth in resisting the vertical forces. The absence of corners, which are always weak points in a section, is an advantage in the arch. Small arches, especially, are similar to pipes, in that their whole section acts together. The stresses in an arch are mainly compressive, and this is a very desirable feature in a structure built of a material like concrete.

Under the head of practicability would be included ease of construction and desirable waterway properties. The highly reinforced sections and the arch rings present no difficulties which cannot be overcome by a little more skill, labor and time. The additional cost due to these items is included in the higher prices given to the materials in these structures, and cannot be counted against them again. The shapes of the waterways are the same for the box culverts and the arches to the height of the spring line, so for ordinary flows all the types will be alike in so far as carrying the water is concerned. When flowing full the slight change in the shape of opening due to the arched roofs will have no appreciable effect.

As stated in this conclusion, the shape of the opening is the same for all the types which are compared. They are low and wide and are the best to use with the type "A" section. The relation of the height of the opening to the width will affect the quantity of material in the various sections differently. To determine what this relation of height to width should be for a minimum amount of material in alternative designs of the same waterway, a few trial designs were made. A section 12 feet span and 8 feet rise was compared with a section of the same area of 8 feet 9 inches span and 11 feet rise. The flat section was found to require less material in the type "A" design, where the side walls are heavy, while in type "B," where the walls are thin and most of the material is in the cover, the higher opening is more economical. It is difficult to draw conclusions regarding the arch, but it seems that a longer span with lower abutments is the better to use.

The shape of the opening, however, does not affect the quantities in the section very materially in any case, but it does change the discharge capacity of the culvert. The wider open-

ings have their centers of pressure lower than the narrower openings, so under flood conditions the water will not back up so high in developing the necessary head. The contraction of the waterway under ordinary flow will also be less for the wider opening. Since the wide and low shape of waterway which has been adopted in these designs is the most suitable for its purpose, then the most economical section for this shape of waterway is the most economical section for culverts in general.

As the result of its investigation, the Committee is of the opinion that reinforced concrete culverts are cheaper and equal to any other form of construction. Generally speaking, flat top reinforced concrete culverts may be used for spans up to 16 feet, but where conditions are such that arch culverts cannot be used, they may be built for clear spans of 25 feet. It is preferable to use arch culverts for spans exceeding 16 feet, where conditions will permit.

Committee
A. O. CUNNINGHAM, ***Chairman.***
W. O. EGGLESTON,
JAMES ROGERS,
C. F. LOWETH,
E. AAGAARD.

DISCUSSION.

President.—We have no printed report on this, but the report was read yesterday.

Mr. Montzheimer.—Mr. King has given blue prints to the Secretary, which are open for the inspection of such members as wish to look at them and which show various designs of re-enforced concrete.

Mr. King.—On our road we have gone into this subject quite thoroughly and in fact we use re-enforced concrete to a large extent. Our experience has been, as this report will show, that there has been a material saving in a very great many structures in using re-enforced concrete in place of plain concrete. This varies somewhat with the conditions, but as the report states, the structures are every bit as satisfactory and efficient as plain concrete, and it resolves itself into a question of economy. Generally speaking, in culverts where we use re-enforced concrete we use footing, bench sills and flat top culverts, and also some circular and flat arches. These culverts we construct in dimensions anywhere from 4 and 5 ft. spans up to as high as 20 feet. In fact we have gone even higher, but it is doubtful if there is any economy in a flat top culvert above 16-foot span. The report is, I believe, very complete in itself, and I think should have considerable attention from the Association.

Mr. Penwell.—We are trying now to eliminate small wooden bridges by building concrete structures, not only as a matter of economy, but as protection against fire and affording safety for our trains, as a fire on our line, which has heavy grades and sharp curves, is a serious matter.

Mr. Beahan.—I may say that the I. S. & M. S. Ry. consider that there is no place in the bridge department where you can save as much money or invest it as economically as in taking out a small pile or trestle bridge and putting in a stone or concrete box culvert.

President.—I think most of the roads are coming to that idea.

Mr. Canty.—The design for covering small openings in use by us was gotten up by our bridge department, a standard drawing being made showing spans from 2 feet up to 10 feet. The load on the track is carried theoretically by second hand rails, which are bunched from three up to seventeen under each track rail depending on span. Concrete is filled in around and between rails. We had over 600 openings on my division, and of these have eliminated about a hundred lately, which makes quite a difference in the appearance of the road bed.

Mr. King.—I wish to say in connection with Mr. Canty's remarks that we have done away with rails for supporting our concrete and are using re-enforced concrete as a matter of economy.

Mr. Burpee.—There may be economy in some cases in the use of old rails for reinforcement of concrete. For instance, on roads located at very considerable distances from steel manufacturing centers, not only does the freight charge on standard concrete bars enhance the cost of the same, but it also very materially reduces the price (which to begin with is low as compared with the other) at which scrap rails can be sold. This value will be further reduced by the labor charges in marketing them, as well as interest while waiting for sale.

So while it is true that standard concrete bars will make a better and cheaper reinforcement under some conditions, the circumstance of location may render it advisable to use the rails.

Mr. Staten.—We have built a great many of these rail top culverts, but I cannot see why it is necessary to cover them up with concrete. We have always had clay or stone or such material with which to fill in, and afterwards you cannot tell that it is not a solid structure. It looks like extra expense to put concrete on top.

Mr. Canty.—A continuous road bed, doing away with bridge ties on open culverts and avoiding the possibility of trainmen who are running along the tracks at night from falling into openings, is a sufficient excuse for the work.

President.—Is there any further discussion? This is a very important subject and is becoming more and more so all the time. If there is no further discussion we will pass on to the next subject.

VIII.

METHODS OF ERECTING TRUSS BRIDGES.

(a) Maintaining Traffic.
(b) No Traffic.

REPORT OF COMMITTEE.

To the Association of Railway Superintendents of Bridges and Buildings:

Your committee appointed on Subject VIII presents the following report:

Early in the year circular letters were sent to the various members of the committee and a report, with photographs was received from J. D. Gilbert of the A., T. & S. F. Ry.; letters and blue prints were also received from our president, Mr. Reid, and from I. F. Stern, bridge engineer of the C. & N. W. Ry. These letters have explained the views of the writers so explicitly that we have decided to give them in full as written.

When traffic is to be maintained, all lattice and pin spans, in my opinion, should be placed in position with a traveler, or with the modern derrick car that is now used by the railway companies and contractors.

When no traffic is maintained a traveler would be the most convenient on account of not requiring train crew or heavy expensive track for trains. Many times the bridges are needed before the grading is completed up to the bridge. Where a railway company has a large number of iron bridges to be erected each season, it appears to me that better results are accomplished, especially where traffic is maintained, if the work is done by the company's forces, as a regular bridge carpenter's crew is always required to make the necessary changes for the new work. The regular bridge crews, in their respective sub-divisions, have a better knowledge of trains and thereby avoid delays to traffic that often exist where contractors undertake to do the work without their assistance. During the many years that I was erecting bridges for a bridge company my work was so arranged that I had a regular bridge crew. The results were very successful at all times and the cost of erection was very uniform on the various classes of structures erected.

M. Riney,
Chairman.

J. D. Gilbert, Iron Bridge Foreman, A., T. & S. F. Ry.:

Relative to Subject VIII, I received a letter from the chief engineer of the Santa Fe, giving the cost per ton of the bridges erected in 1907, all of which were on the main line and we had all the trains to contend with. All the girders and eye beams

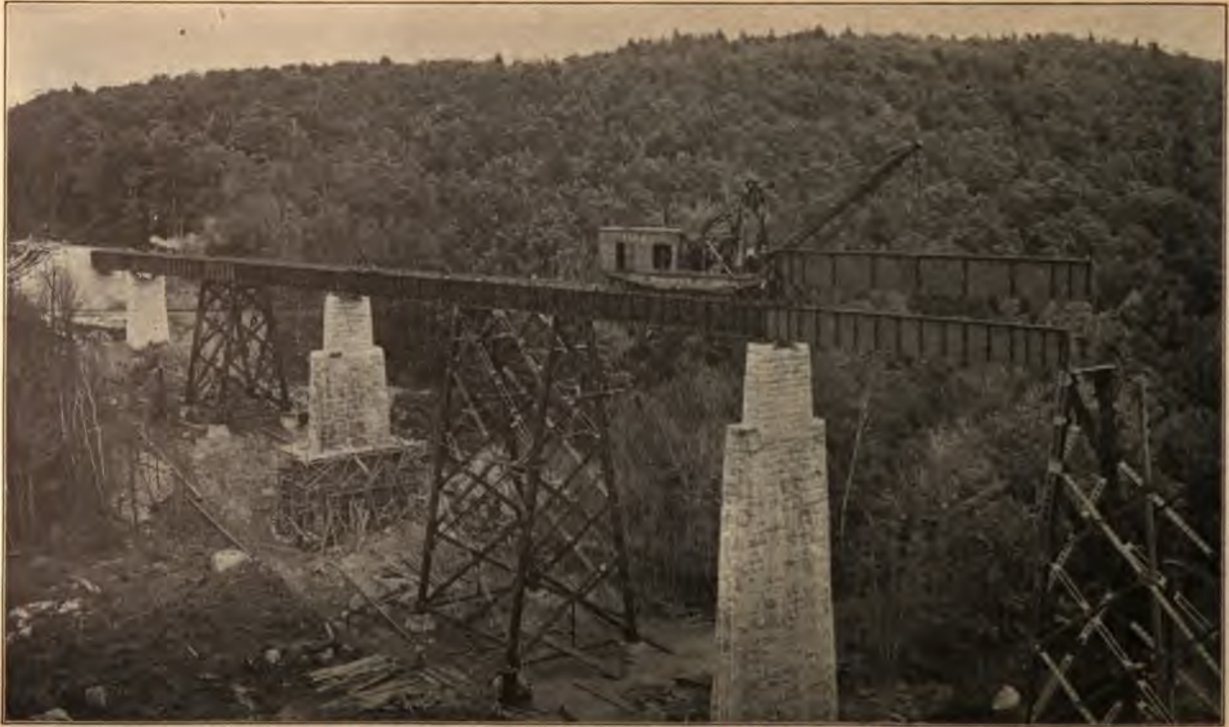


FIG. 36. Greenville, N. H. Viaduct, Boston & Maine R. R.

Tower spans, 28 to 40 ft.; main spans, 66 ft.; built and erected by the Boston Bridge Works. Towers erected by guy derrick with long boom set up within the tower. Girders and floor erected with self-propelling derrick which unloaded and brought in all material. Traffic, which was discontinued upon the burning out of the old deck wooden bridge, was resumed as soon as the last girders were in place. One stone pier was badly burned for 20 ft. up from the ground. The view shows the forms for the concrete jacket with which it was reinforced.

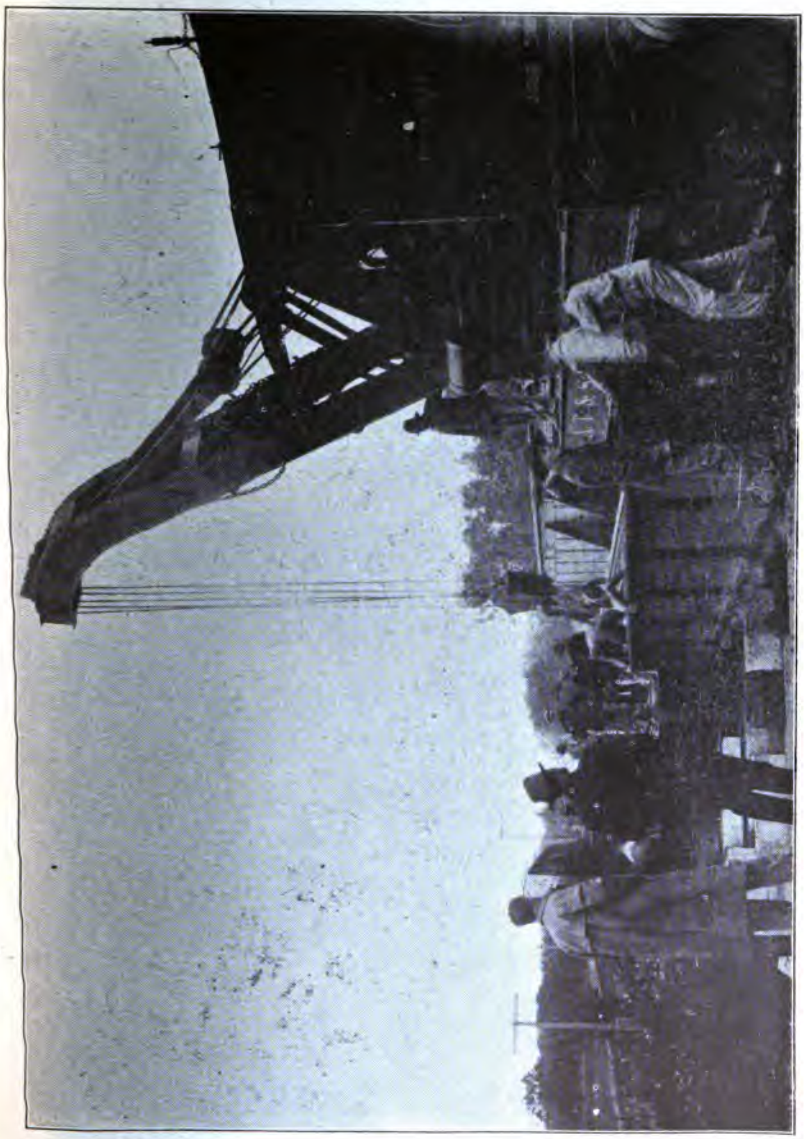


FIG. 87. Bridge Erecting, A. T. & S. F. Ry.

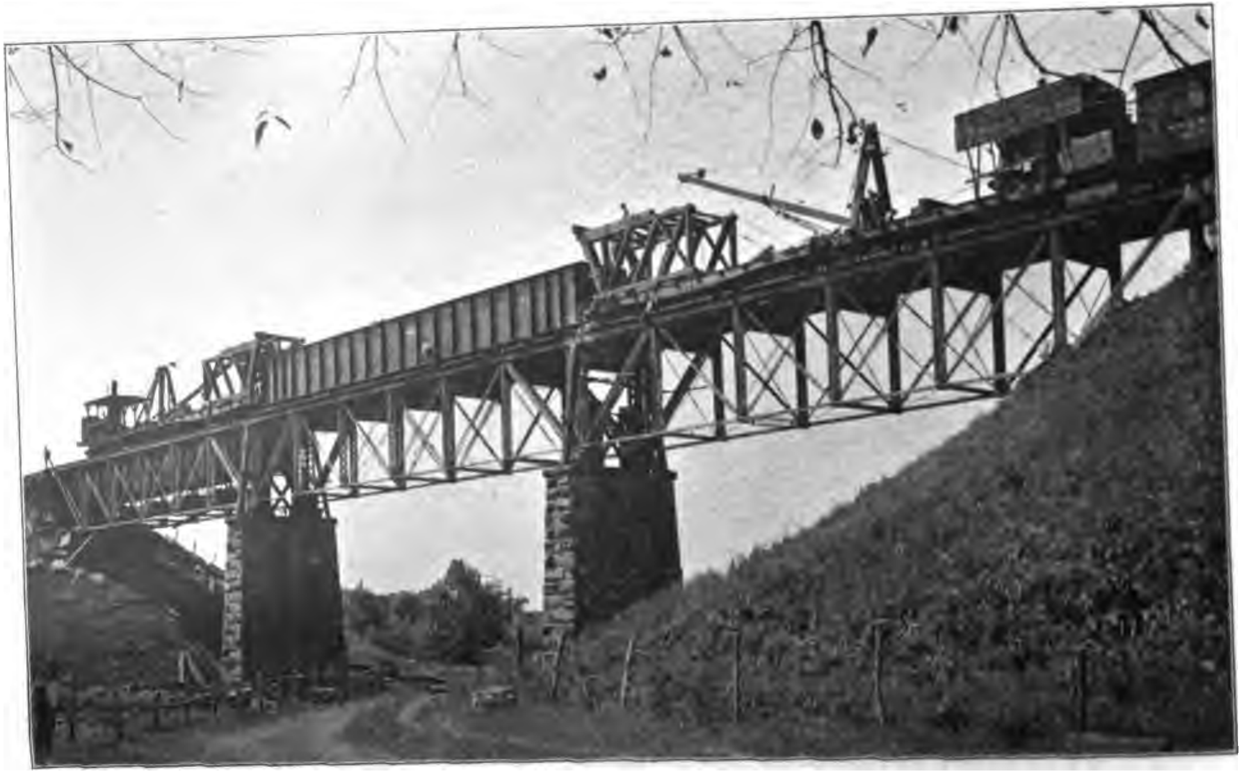


Fig. 88. Erecting Girders, A. T. & S. F. Ry.

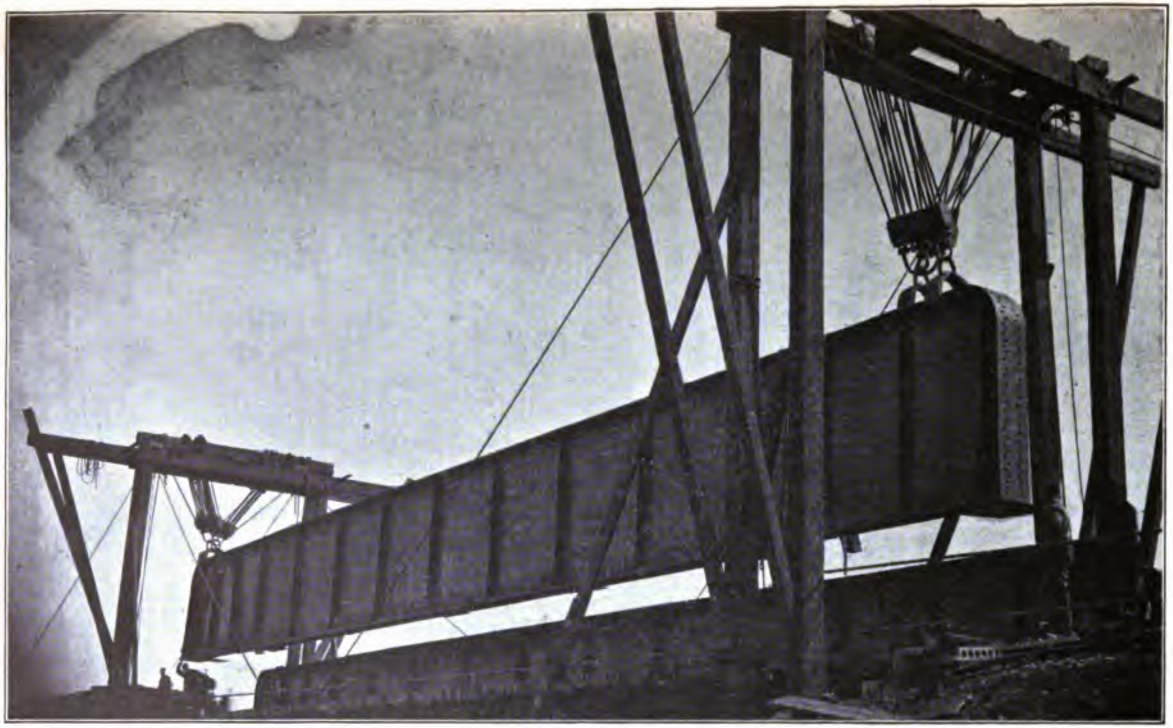


FIG. 39: Placing Girders, A. T. & S. F. Ry.

were erected with steam wrecker and the through spans with the derrick car.

The average cost of trusses erected, of which 984 tons are included, is $4.63 per ton; of girders, of which there were 2,784 tons erected, $5.49 per ton; eye beams, of which there were 2,837 tons erected, $2.88 per ton. You will notice that our girder work cost more than our trusses, for the reason that a good part of the former was on second track, where one old girder span had to be cut apart, girders moved to the outside and heavier girders set in their places. The gang traveled over 5,000 miles, the cost of moving was charged to the bridges, and our riveting was all done by hand. We have now in operation a 30 H. P. gasoline engine and 10 x 10 air compressor fitted up on a car. We have five "Boyer" hammers, three little giant drills and reamers, and expect to do our work a great deal cheaper in the future than we have in the past. I also expect to have in operation some time during the summer a new steel 60-foot derrick car, with an 8-spool and double drum hoisting engine, derrick car to have two booms, one 45 feet and one 60 feet. It will be built to set 100-foot girders, and as we have on the Santa Fe, in the mountains, a number of bridges across deep canyons, where it is difficult to put in falsework for erection and hold it, on account of mountain floods, this car will be used in placing girders across such places without the aid of any falsework, and at a very small cost, compared with the way the work is done nowadays.

During the erection of some of the spans in Apache Canyon, Gloriaeta Mountains, where the old girders had to be moved and cut in two in the center, I had to put in some 64 Class A girders underneath old girders, while I cut the latter in two in center to put in cross girder to connect the main girders to. I used these 64-foot girders to block up on to carry traffic, while preparing to put in the new girders. I used my derrick car on one end and the steam wrecker on the other. The Santa Fe use their largest class of engines on this mountain, employing two pushers for every train, which is pretty hard on bridges; some of them are on 10-degree curves. The heaviest girders we have on the Santa Fe are between Gloriaeta and Lamy station, a distance of about 11 miles, where the Santa Fe crosses this canyon 14 times. For the erection of the heaviest spans, which were ballast deck through girders 110 feet long, 19 feet center to center, on a 10-degree curve, I used double gallows bents at each end, with a road engine and snub car to set girder in place. I also use this kind of rigging for all deck girder work. This is a safe and very economical way of handling this class of girder.

I. F. Stern, C. & N. W. Ry.:

I have been trying to figure out what data I could give you from our experience on this road with regard to the subject of erection. While we have done considerable erection, the whole matter resolves itself into just one thing—to do the work for the least money with the smallest amount of interruption to traffic. Most of our work, as you well understand, is under traffic, and I estimate that in the past three years we have erected about six to ten thousand tons. We have three derrick cars with the accompanying equipment so that three crews can be kept busy at the same time. These derrick cars are 80,000 lb. flats, upon which is mounted about a twenty-horse power engine, capable of lifting about twenty tons. When we have a greater weight than this, we either have to use two derrick cars or build a gallows frame for one end.

The question has often been raised as to whether the quality of work done by a bridge erecting crew, working under the direction of some official of the railroad company, is equal in grade to that done by the contractor. My experience has been that ordinarily it is not, and this is due to the fact that on most railroads the bridge erecting crew, unless working under a contractor, have no inspector to keep after them. It is impossible for a foreman to get the proper work out of his crew unless he can have an inspector on the job to insist on it being done. Even though the foreman desires to have the work up to the proper standard, the crew will balk and think him fault-finding, and in some cases sulk to such an extent that the work becomes more or less disorganized. With our own foremen we have our own inspectors on the job. These inspectors look after all the clerical work and keep the time. The inspectors check up the foremen in exactly the same manner that we would check up a contractor, and as a result, our work has improved to a considerable extent in the past few years and no criticism can be made regarding its quality.

Erection is costing the same today as it did some years ago, the increased efficiency of the crew being offset by the increase in wages paid the men. I am not at liberty to advise the cost of erection per ton for the various classes of structures, but will say that it runs considerably under what we can contract it for, so that our bridge erection shows a considerable saving by running our own crews.

We are now erecting the Clinton bridge. This is a contract job and is being done without traffic over it. A very complete set of progress photographs are being made of this work and I would suggest that you write Mr. Carter, asking him to send you some of these photographs, which I think would be very interesting, if reproduced in connection with your paper.

W. J. Mellor, M. L. & T. R. R.:

The new steel crossing of the Morgan's Louisiana & Texas R. R., over the lower Atchafalaya River at Morgan City, La., is nearing completion. This structure spans a stream approximately 1,700 feet across, with a depth ranging from 75 to 95 feet.

The sub-structure is of concrete and consists of eight piers which were put down with caisson by the Missouri Valley Bridge & Iron Co.

The superstructure, consisting of six 235-foot through truss spans, one 270-foot draw span, together with one 80-foot and one 40-foot girder which were erected by the company's forces.

The work of erection was conducted as follows: The spans were assembled each in turn on falsework, at a point near river bank, about 1,500 feet from structure proper, and were then

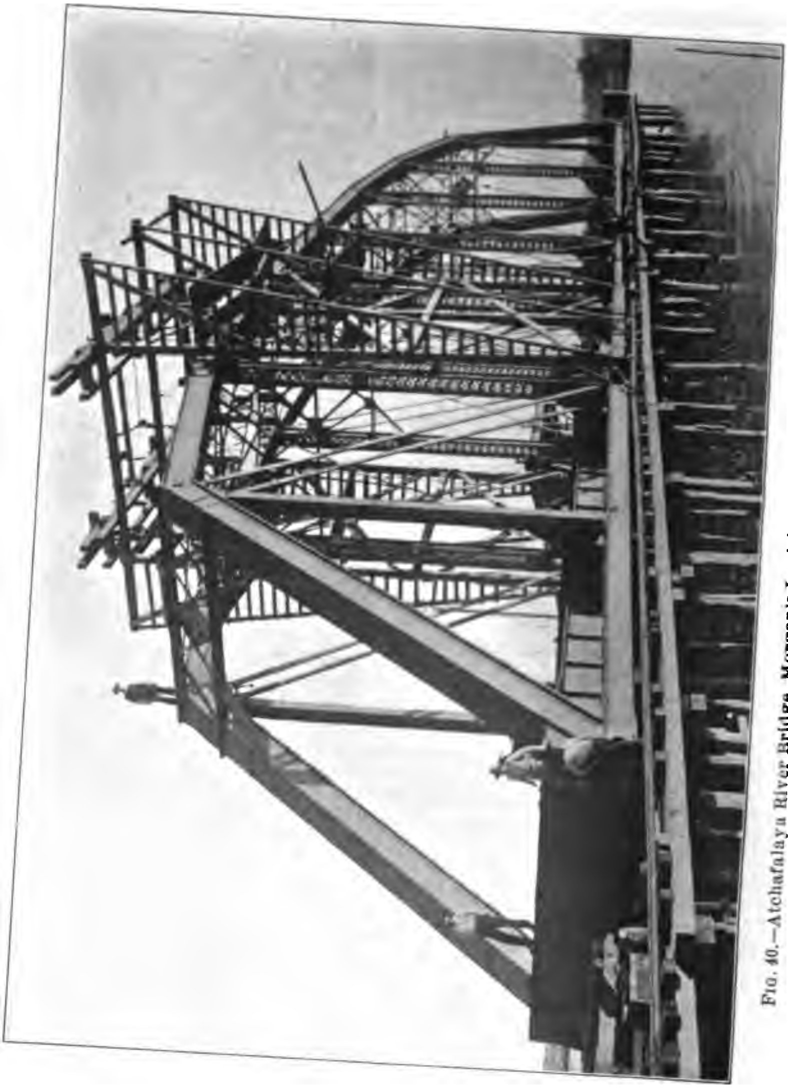


FIG. 40.—Atchafalaya River Bridge, Morgan's Louisiana & Texas R. R. & S. S. Co., Morgan City, La.

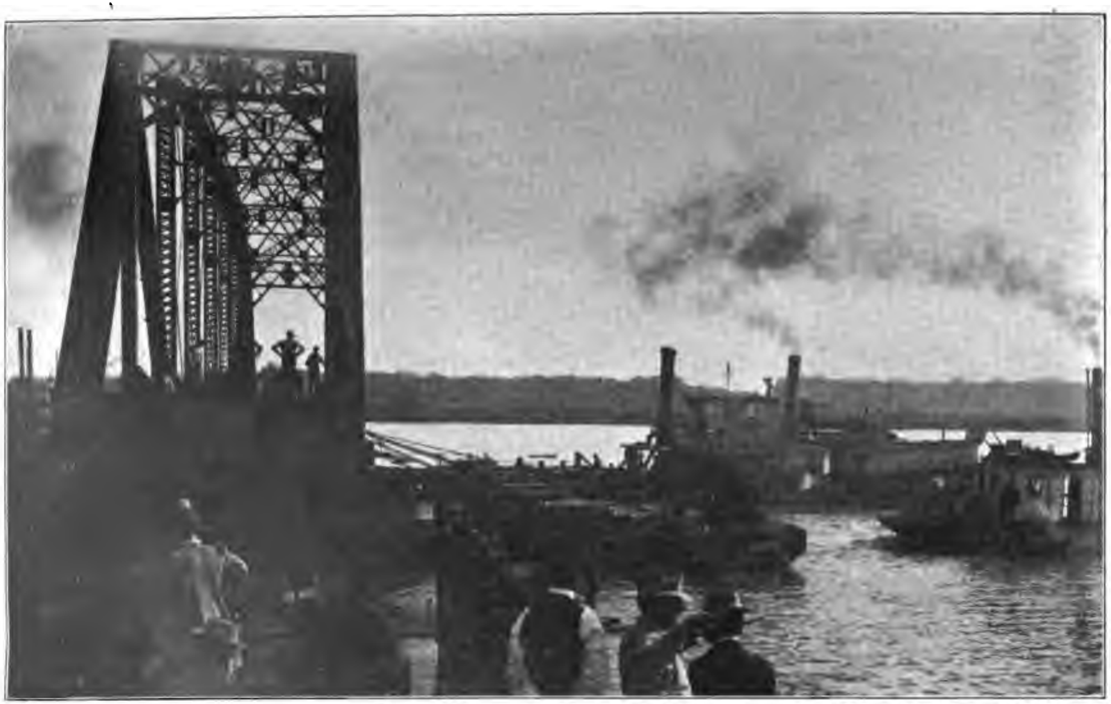


Fig. 41.—Completed Span, Atchafalaya River Bridge, Morgan's Louisiana & Texas R. R. & S. S. Co., Morgan City, La.

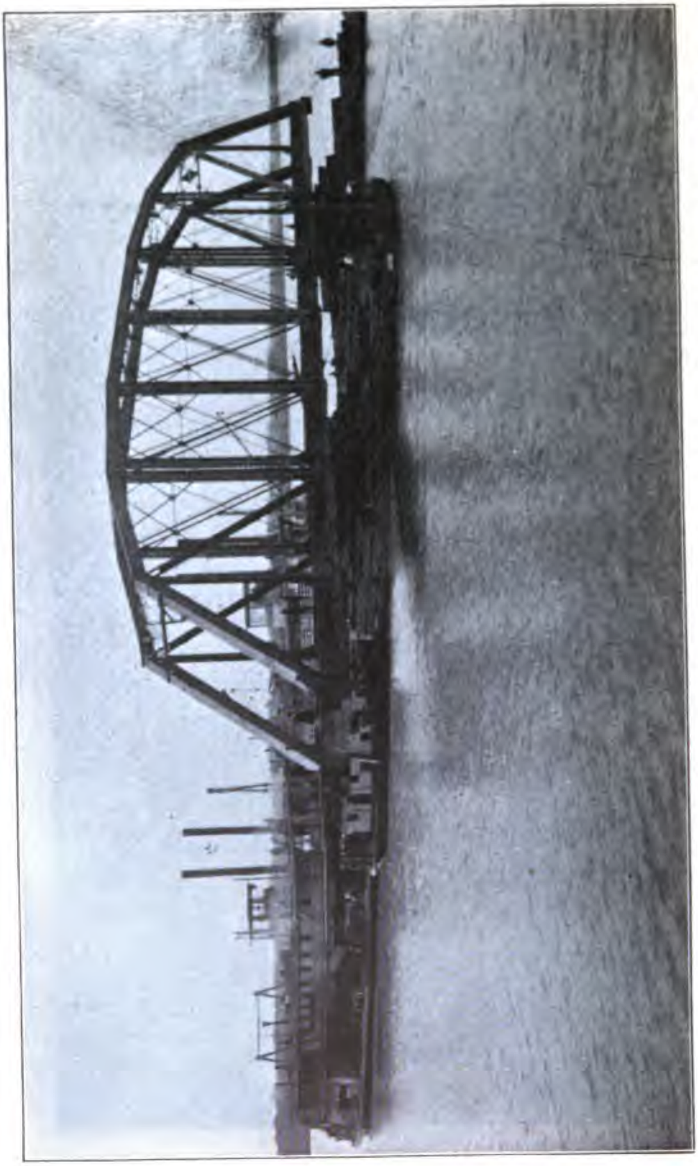


FIG. 42.—Span on Barges, Atchafalaya River Bridge, Morgan's Louisiana & Texas R. R. & S. S. Co., Morgan City, La.

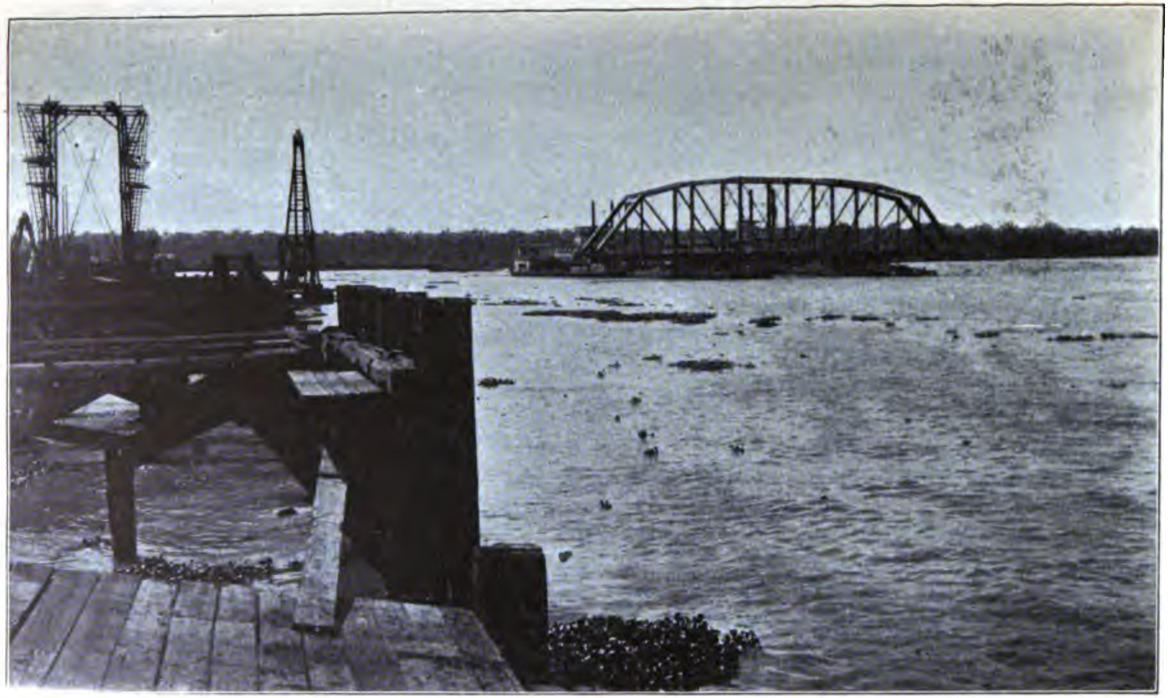


FIG. 43.—Span floating to position, Atchafalaya River Bridge, Morgan's Louisiana & Texas R. R. & S. S. Co., Morgan City, La.

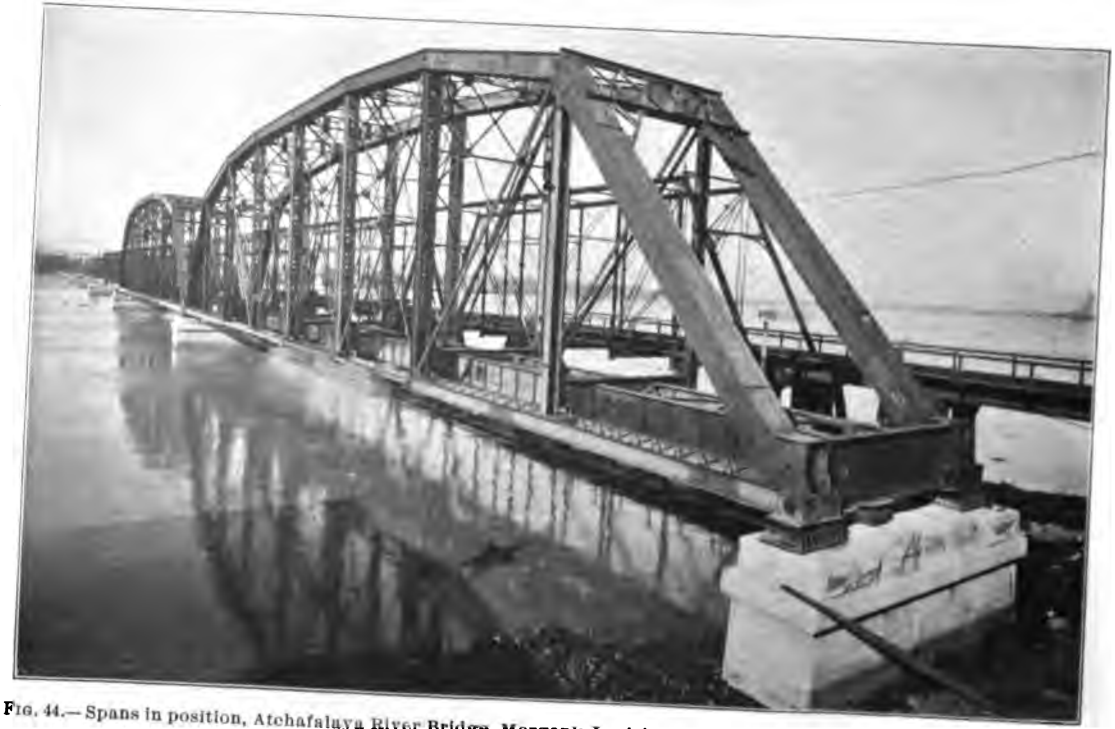


FIG. 44.—Spans in position, Atchafalaya River Bridge, Morgan's Louisiana & Texas R. R. & S. S. Co., Morgan City, La.

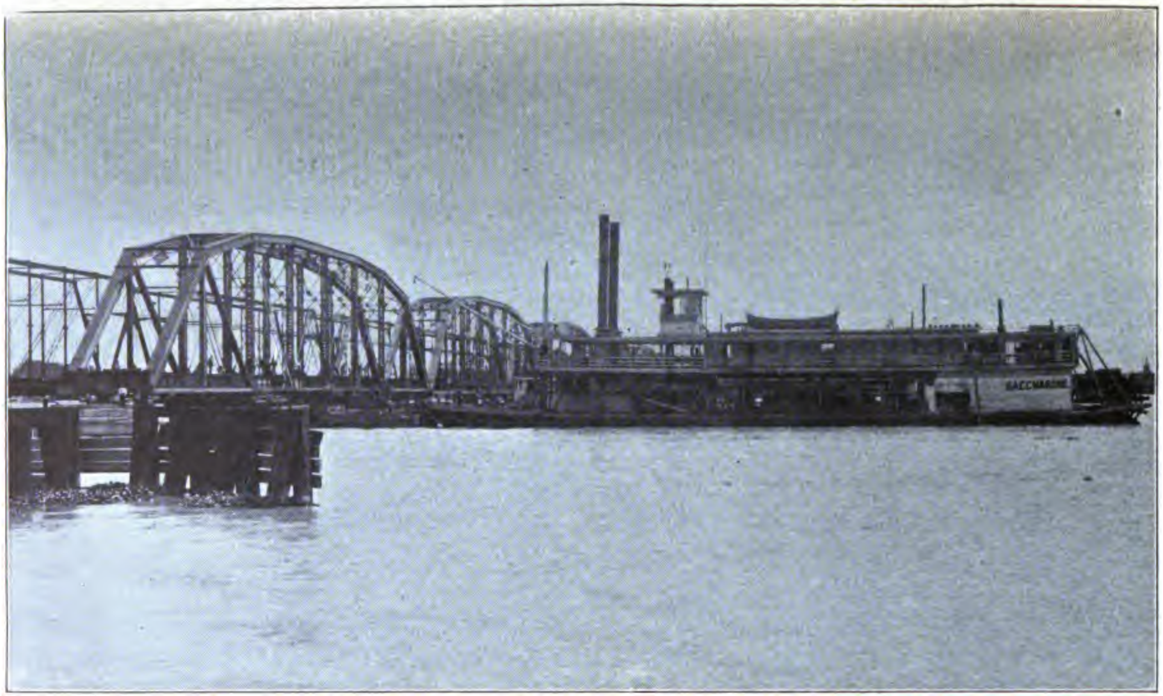


Fig. 45.— Landing of fourth Span, Atchafalaya River Bridge, Morgan's Louisiana & Texas R. R. & S. S. Co., Morgan City, La.

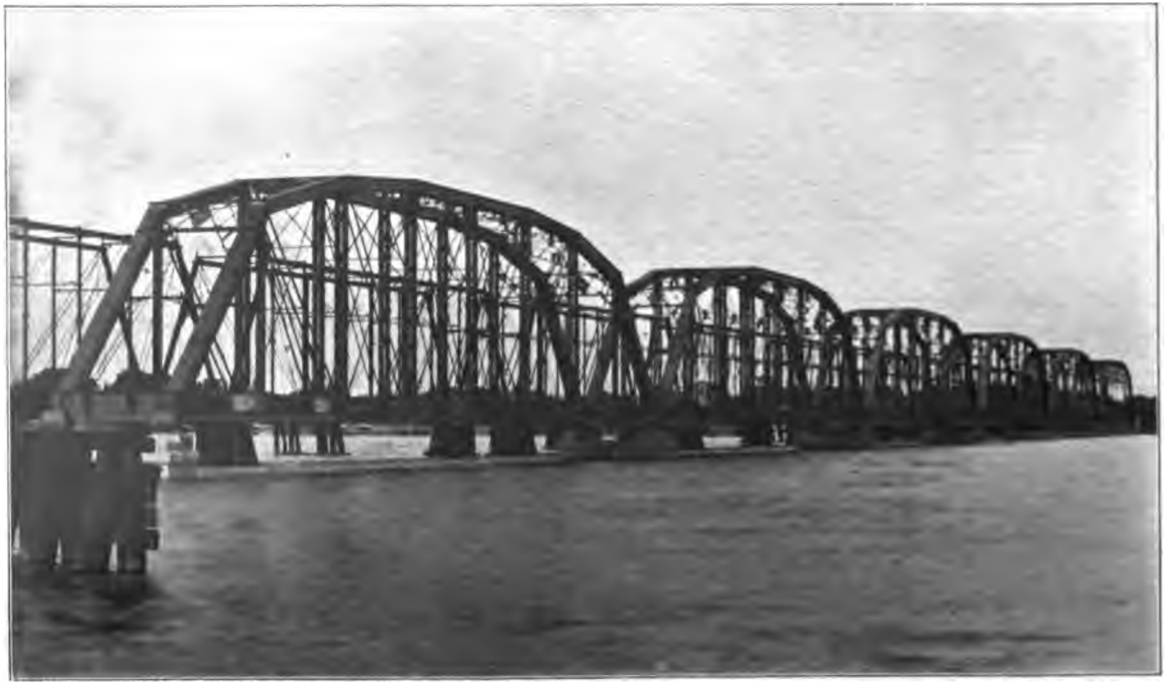


Fig. 46.—Completion of sixth Span, Atchafalaya River Bridge, Morgan's Louisiana & Texas R. R. & S. S. Co., Morgan City, La.

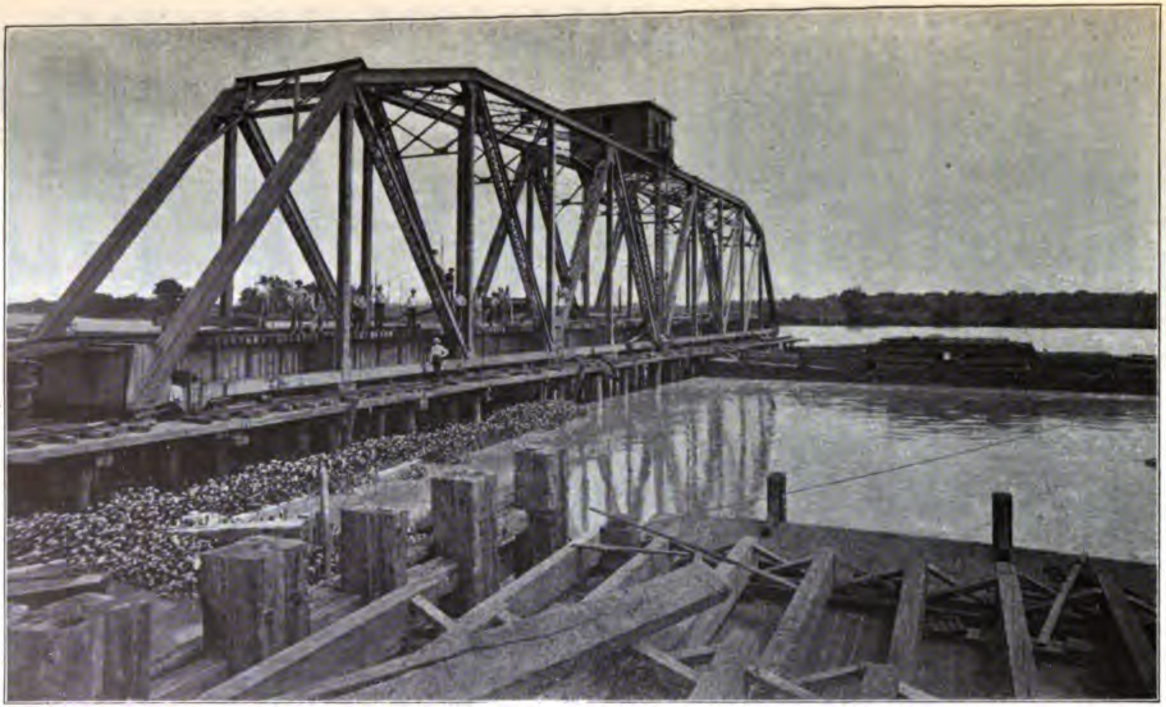


Fig. 47.—Draw Span ready to float to position, Atchafalaya River Bridge, Morgan's Louisiana & Texas R. R. & S. S. Co., Morgan City, La.

floated into position on two barges measuring 24 x 110 feet with 6-foot hold, which were submerged by opening a six-inch valve and floated into position under the span and then pumped out with a six-inch steam syphon. A graduated cribbing having a surface of ninety feet at bottom was used to distribute the load and protect deck of barges. These were then towed out into mid-stream and span floated into permanent position. The structure was deposited on piers by opening valves and allowing barges to fill with water. Two large steamboats were used for towage.

Accompanying this description are eight photographs showing pictorial progress of the work.

Fig. 40 shows span on falsework in process of erection. (Note traveler distributing structural material.) Fig. 41 shows span complete and ready for towage. Fig. 42 shows span on barges being floated to position on piers. Fig. 43, a distant view of span on way to landing. Fig. 44 shows permanent structure after second span has been placed into position. (Note contrast as to substantiality between old and new structures.) Fig. 45 shows successful landing of fourth span. Fig. 46 shows completion of sixth span. Fig. 47 shows draw span on falsework, completed and ready to be towed into position. This, however, will not be attempted till all the balance of the crossing, approaches, etc., are completed and we are ready to divert the traffic from the old to the new crossing. This draw will then be towed to its position and the old draw removed, so as to cause as slight a discontinuance of marine traffic as possible.

Records show an average traffic of about one boat per hour through this stream, and we have figured on making the change with an interruption to river traffic not to exceed forty-eight hours.

Plans were designed and work successfully carried to the present stage by W. J. Mellor, superintendent of bridges and buildings, Louisiana Lines.

DISCUSSION.

Mr. Riney.—Printed copies of the committee report on this subject have been distributed. Perhaps we have not secured as much information as should be furnished on this important question, but we are unable, just at present, to add anything further to report.

However, our printed statements may cover all that is advisable at this time, as you are well aware that methods of erection have, in a measure, become standardized in recent years and many of our members are familiar with the modern practice.

Mr. A. S. Markley.—I would like to ask why the M. L.

& T. Rd. used the method shown in the report of erecting the spans and then floating them into place.

Mr. Montzheimer.—The report shows that the water there is from 75 to 90 feet deep.

Mr. Staten.—I am erecting many bridges but I do not believe I ever put one up as cheaply as the one spoken of in the report, where the price given is $4.63 per ton. We have contracted some of our bridges and paid as high as $18 per ton for four 122-foot spans, and the timekeeper on the job told me after it was done that it cost them everything they got for it. The erection price shown in the report looks very cheap. I have erected as cheap as $6.50 to $7 per ton, where all conditions were good, but I never got it down that cheap.

Mr. Cahill.—We erected a 150-foot draw span deck girder over a creek. We could not take out the old and erect the new one at the same time, so the contractors sunk lighters under the old span and floated it off and in the same manner floated the new one into position. In these southern waters the depth is so great that you cannot use false work.

Mr. Jutton.—The C. & M. W. Ry. Co. has recently erected a bascole bridge over the Chicago River, just west of their depot. This bridge replaces the old draw span and was erected just south of the old bridge. The new bridge has but one leaf which operates on the east abutment and was erected with the leaf in a vertical position. In order to erect the new bridge and to swing the old bridge during erection, it was necessary to cut off the east end of the drawbridge. A pile bridge was put in to take the place of the part removed and a counterweight was put on the east end of what remained of the draw span. This work was done one Sunday, between the hours of 9 a. m. and 6 p. m., and was executed in a very satisfactory manner. The removed part was left standing on the protection pier and was taken down later.

After the new bridge was completed and ready for traffic, the remaining part of the old bridge was removed by floating it away on scows, to be taken apart.

For the foundation of the new bridge a cassion was sunk to a depth of about 55 feet. Then six wells, each about 10 feet in diameter, were excavated about 55 feet farther to rock, making a total depth of about 110 feet. In doing this work the air pressure used was only 14 pounds per square inch.

The photographs which were taken at frequent intervals during the work are very interesting.

President.—If there is no further discussion we will pass to the next question.

IX.

SMOKE JACKS FOR ENGINE HOUSES.

REPORT OF COMMITTEE.

To the Association of Railway Superintendents of Bridges and Buildings:

This should be considered as a continuation of last year's report on Smoke Jacks, and deals more particularly with wooden and composition jacks, or a combination of the two. Material for composition jacks is made up of asbestos, cement and other materials of a like nature.

It is generally well known that smoke jacks come in contact with one of the most destructive agents in connection with railroads, namely, the gases resulting from the combustion of coal in locomotives. The question therefore of repairs for jacks is probably the most difficult and annoying one that the man has to deal with who has charge of the maintenance of engine houses.

There are various good reasons for the general desire to get away from the practice of using the cumbersome and short-lived iron and tile jacks, which materials have been in use so long. These jacks are still in common use on a majority of the railroads today, principally for the reason that other kinds have not been entirely satisfactory in all respects. This matter has been thoroughly discussed in past meetings of the association.

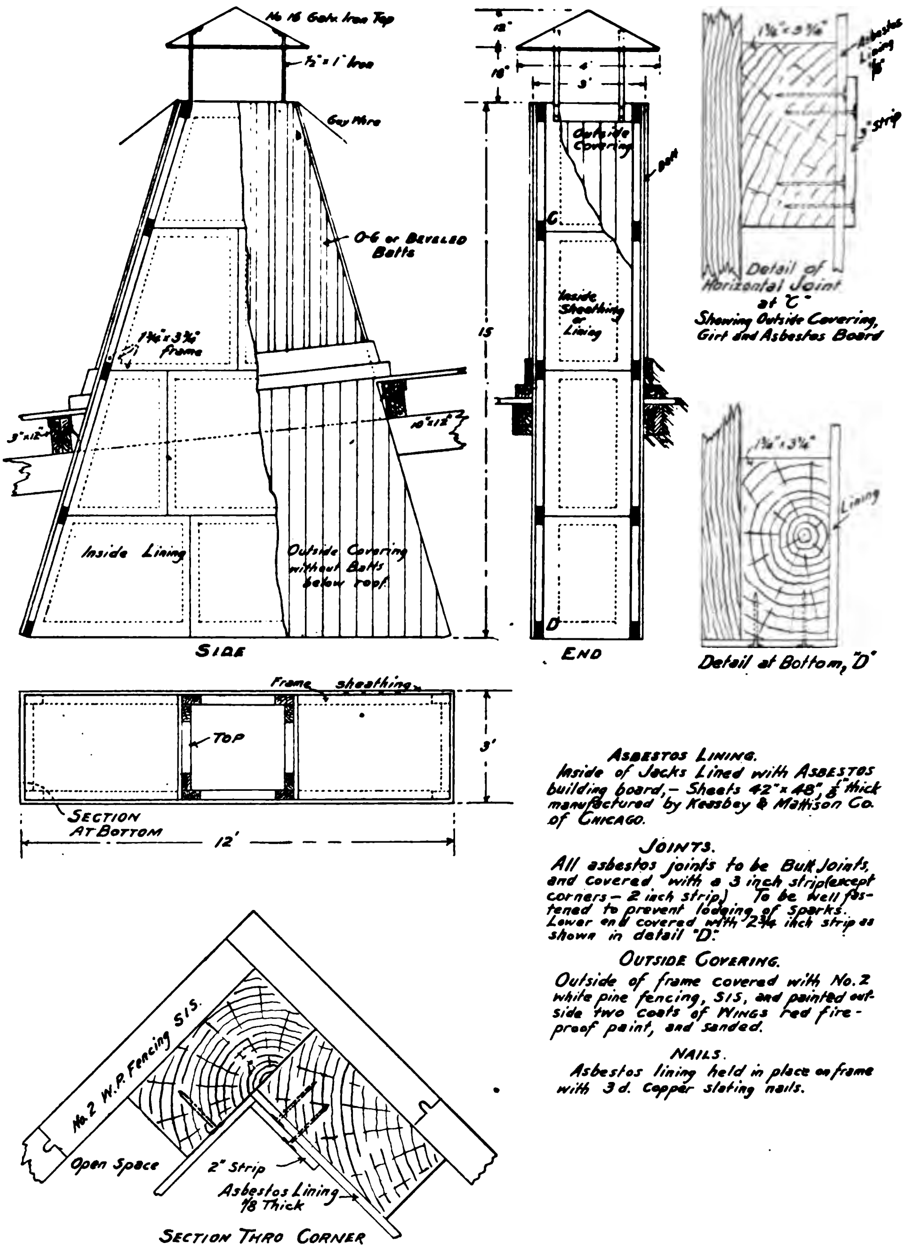
KINDS OF FUEL USED.

One phase of the subject has been given very little consideration in the reports and discussions in the past, which has a direct bearing upon the case, and that pertains to the various kinds of fuel used in the firing up of locomotives. Some roads do not use soft coal but use oil or hard coal, thereby avoiding the hot cinder, and not having to contend with the sulphurous gases arising from steam coming in contact with the combustion of some grades of western bituminous coal, which is a decidedly deadly enemy to metals, and sooner or later disintegrates metal jacks, or the fastenings for other styles.

MATERIALS.

Wooden jacks have been in use for upwards of twenty years on some roads and have been in use on various roads throughout the country for a less number of years, and perhaps the principal reason why they are not being almost universally used is on account of the fact that they are regarded by many as being the cause of fires.

The subject of wooden jacks has been so thoroughly handled by the Association in the past that it is not necessary to reiterate it



ASBESTOS LINING.
Inside of Jacks Lined with ASBESTOS building board,— Sheets 42"×48", ⅛" thick manufactured by Keasbey & Mattison Co. of CHICAGO.

JOINTS.
All asbestos joints to be Butt Joints, and covered with a 3 inch strip (except corners — 2 inch strip). To be well fastened to prevent lodging of sparks. Lower end covered with 2¾ inch strip as shown in detail "D."

OUTSIDE COVERING.
Outside of frame covered with No. 2 white pine fencing, S1S, and painted outside two coats of WINGS red fire-proof paint, and sanded.

NAILS.
Asbestos lining held in place on frame with 3 d. copper slating nails.

FIG. 48.—Chicago, Burlington & Quincy Ry., Standard Wooden Smoke Jack, lined inside with Asbestos Building Board.

in this report. Suffice it to say that it is certain that on many roads they are a success, which may depend largely upon their design, construction and care during the first few weeks of their use, after which they become saturated and coated with a sort of creosote or soot, which seems to protect them from danger by fire thereafter.

Treated wood having fireproof qualities has come into use for this purpose lately and ought to make a good showing. Jacks constructed of this material are in use at the present time, and are reported as giving satisfactory results.

The earlier types of moulded asbestos jacks may be classed as failures, having shown an average life of about two and one-half years, or less. The vitribestos jack so highly commended in last year's report (page 213) has failed, after having been in service about three years and nine months. Very few, if any, roads have had a successful experience with the moulded types of asbestos jacks.

Many roads within the past two years have been experimenting with a material known as asbestos board or transite board, made of asbestos, cement and other like materials (as stated elsewhere), which comes on the market in sheets of varying thickness to suit the style of jack for which it is to be used. The jack may be constructed complete of this material, the plates being about ⅜-inch thick and stiffened with angles of the same material and a specially moulded hood; or it may be used as an inside lining for wooden jacks, where the material is only about ⅛-inch thick.

Accompanying illustrations show the use of this material in both styles of jacks. Some railroad men are so enthusiastically in favor of this material as to be willing to equip all of their houses with jacks made from it, regardless of the result, trusting it to be the long looked for material for making the ideal jack. Some manufacturers build these jacks and agree to keep them in repair for a specified term of years, which may be the reason why railroad men are supporting the material so strongly. Nevertheless, it must be admitted that these compositions are only in the experimental stage, for they have not been in use a sufficient length of time to determine their value. Even if the lasting qualities are found to be satisfactory, the matter of fastenings is liable to be more or less of an annoyance for some time to come.

DESIGN.

Most jacks of either class of material, as above described, are of rectangular pattern and generally of two distinct types, both having a considerable length of opening at the bottom, giving a wide range for the spotting of engines, the one tapering gradually its entire length from bottom to top, as shown in the Chicago, Burlington & Quincy design, the other tapering more abruptly below the roof, into the body of the jack and thence of an almost uniform size to the top, as shown in drawing representing the Chicago Lake Shore & Eastern jack. The former, having less angles, probably discharges the smoke and gases more freely, especially when the engine is not spotted directly under the center of the hood, and when the atmosphere is heavy.

Many of the modern style jacks having large openings are pro-

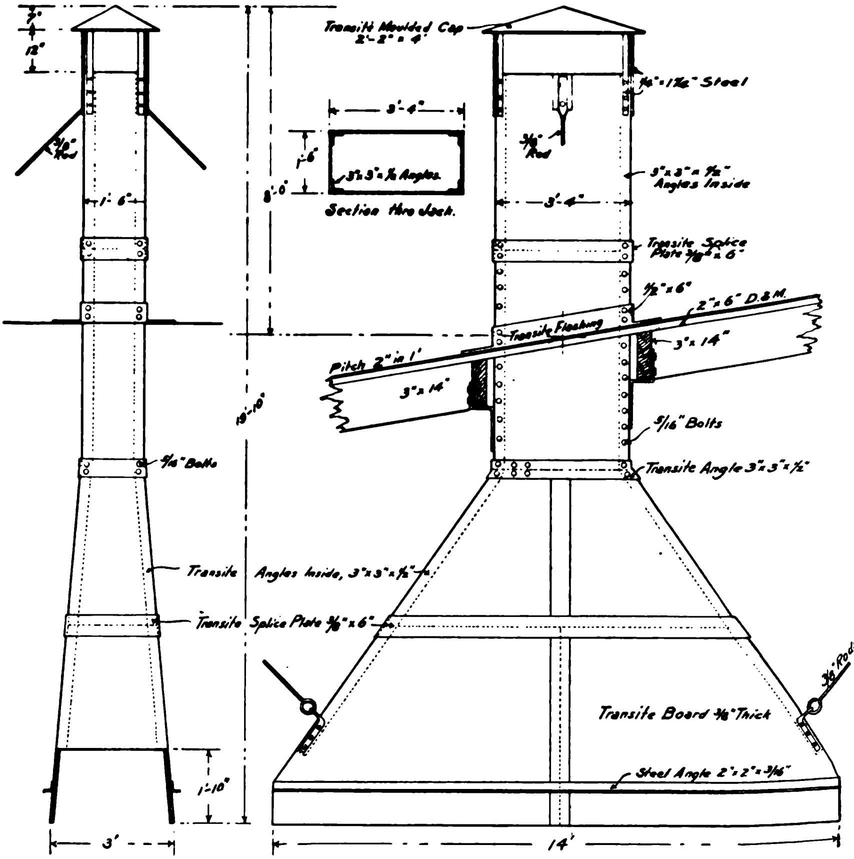


FIG. 49.—Chicago, Lake Shore & Eastern Ry., Standard Smoke Jack, built exclusively of Transite Board.

vided with a damper, which may be closed, when not in use, during the coldest weather, in order to prevent the loss of heat, which it is necessary to guard against in more northerly climates.

The committee is of the opinion that where the conditions are such that a wooden jack can be used successfully, properly designed and constructed, it is the most durable and economical jack known at the present time.

[Extracts from Letters.]

The Atchison, Topeka & Santa Fe (coast lines) reports the use of Roe jacks on the engine houses at Albuquerque, Gallup, Winslow and Seligman with good results, as they are adjustable to any height of engine stack. The Dickinson cast iron jack also is in favor on the Los Angeles division. This is the telescopic pattern adjustable jack, counterweighted from a lever, similar to that shown on page 212 in 1907 proceedings.

A member of the Southern Railway says: We are using several kinds of jacks, cast iron, wood, asbestos, etc. The cast iron and wooden jacks are not satisfactory. I believe that the composition jacks will be, although we have been using them only about two years and cannot therefore say from experience just how satisfactory they may prove to be.

The Long Island Railroad has been using wooden smoke jacks for upwards of twenty years. They also have some Dickinson cast iron jacks. They report excellent service from both kinds. The Master Carpenter of their road says: "The wooden smoke jack wears, I think, the best of any which I have ever seen. Of course there is always more or less danger of fire with a wooden jack, but I cannot recall ever having known of an engine house burning down from the use of a wooden jack. I favor a wooden jack in all cases, except where the fire risk is too great. The Dickinson jacks give excellent satisfaction. The only fault I have to find with them is that they are thin and more or less liable to be damaged in shipment and erecting, but when once installed they answer every purpose, and are free from corrosion or any of the troubles which usually follow a metal jack, this principally on account of their being made of cast iron. There is one feature in connection with them, however, that requires close attention, and that is to see that the suspension rods are not neglected, permitting the jack to fall.

The Chicago, Burlington & Qunicy R. R. submits drawing of a wooden jack lined with asbestos building board one eighth of an inch thick. The drawing is sufficiently clear as not to require further description. They are using quite a number of this style of jacks and they are reported as being satisfactory, after having been in use from one to two years.

The Great Northern Ry. has adopted a lined wooden jack similar to that used by the Chicago, Burlington & Quincy Ry. They formerly used a lined wooden jack, with general shape similar to illustration shown herewith as representing the C. L. S. & E. Ry. jack, having a longitudinal opening at the bottom of ten feet. Both styles are lined with transite. The latter kind has been in use two years and has given good satisfaction. Where the engines were spotted anywhere near the center of jack, they gave no trouble from any cause.

The wooden jacks, lined with cement on expanded metal, as used by the Northern Pacific Ry., and shown on page 206 of last year's proceedings, are said to be a failure as far as the concrete is concerned. They are not satisfactory and will probably soon be replaced with something else. At present they are being used simply as a wooden jack.

Illustration is shown herewith representing wooden jack as used by the Baltimore & Ohio Railroad. This jack has no other lining than wood, and varies from most jacks of this style in having the boards run horizontally. A member of that road quotes as follows: We have used on our system every type of jack that has ever been made in the way of metal or terra cotta. We have but lately commenced the use of wooden jacks, and we are as yet not fully prepared to express an opinion as to their comparative merits with those of metal jacks. I am, personally, however, inclined to believe that we are obtaining very satisfactory results from

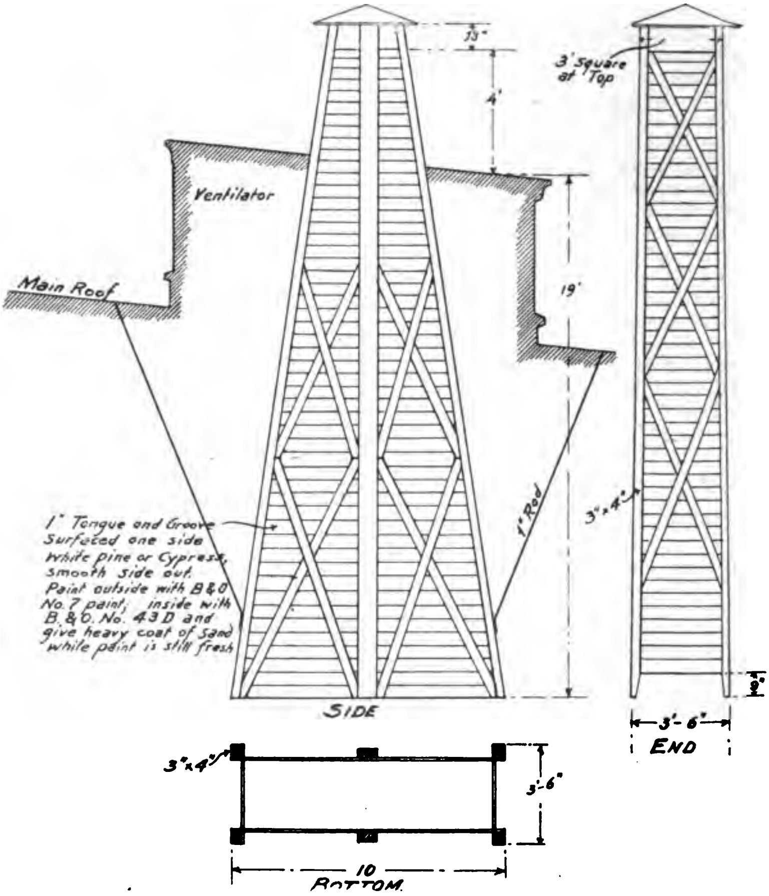

13"
4'
3' Square at Top
Ventilator
Main Roof
19'
1" Rod
3"x4"
1" Tongue and Groove Surfaced one side White pine or Cypress, smooth side out. Paint outside with B&O No. 7 paint; inside with B.&O. No. 43 D and give heavy coat of Sand while paint is still fresh
SIDE
3'-6"
END
3"x4"
3'-6"
10
BOTTOM

FIG. 50.—Standard Wooden Smoke Jack, Baltimore & Ohio R. R.

smoke jacks made of wood. We have installed a few of them on several roundhouses on the system, and have lately placed four of them on our roundhouse at Glenwood, Pittsburg. These are giving us such good results that we have arranged to equip the entire house with the same style of jack. The Paul Dickinson Co. has lately put a wooden jack on the market built of especially prepared wood, which I believe to possess considerable merit, and we are arranging for the installation of one as a test. The design of this jack is very neat, and gives a much better appearance than the jack shown on attached blue print. In conclusion, I would state that it is my opinion that the wooden jack, properly built and kept well painted, would prove to be more economical than any other jack that we could place on a roundhouse.

A member of the Louisville & Nashville Railroad says: It seems that in the years that this subject has been before the Bridge and Building conventions it has been pretty fully covered, and I have looked to these reports and discussions as embracing the best existing information and data. The subject of the best smoke jacks. will remain more or less a matter of opinion until some time in the future when some good material and type of construction for engine house smoke jacks may be found and adopted. In my limited experience we have used sheet iron, sheet steel, cast iron, untreated wood, vitribestos and malleable iron jacks of almost all shapes and styles of construction, none of which have ever proved fully satisfactory. We have in use now on my immediate division a few of the Dickinson patent cast iron jacks of both the stationary and telescoping pattern. The upper portions above the roof are designed in length and style to fit various styles of roof construction, but these jacks of cast iron, especially those with a telescoping bottom section, have given only ordinary satisfaction, due to the rapid deterioration of the metal from corrosion and the disposition to carelessly handle the telescoping bottom section. Cost of these cast iron jacks is varied as stated on account of their use in various types of roof construction. Sheet iron, sheet steel or green wood types of smoke jacks have been entirely discarded here on account of very unsatisfactory results. We installed five years ago, on trial, three vitribestos jacks, a type of jack manufactured by the Chicago Fire Proof Covering Co., and later, a number of the same type of jacks were installed on some engine houses on some of our Southern divisions. While first cost was much cheaper than iron jacks I am compelled to say that vitribestos jacks of this company's manufacture have proven worthless. We installed on this division seventeen malleable iron smoke jacks of the Bruyn Patent, lever lift type, as manufactured by Illinois Malleable Iron Co. in 1903. So far these jacks show very little deterioration on account of rust and we have had no breakage. I am satisfied from observation so far that these malleable cast jacks are decidedly the best jack so far used in my territory. They cost F. O. B. cars at manufactory about $80 per jack of the style needed for the roof in question. I am not able to furnish you with blue-prints of any type of jack in use in my territory.

A well known member of the Boston & Maine Railroad has the following to say in regard to the use of jacks on that road: Nearly all of the jacks that we have are unsatisfactory from one cause or another. Our former jacks were cast iron hoods with gutters, plate iron waist above the hood and vitrified pipe stack outside the roof. These were heavy. The hoods were supported to the roof timber by rods, which rusted off, letting the hoods fall. The light waists corroded quickly and even the vitrified stack went

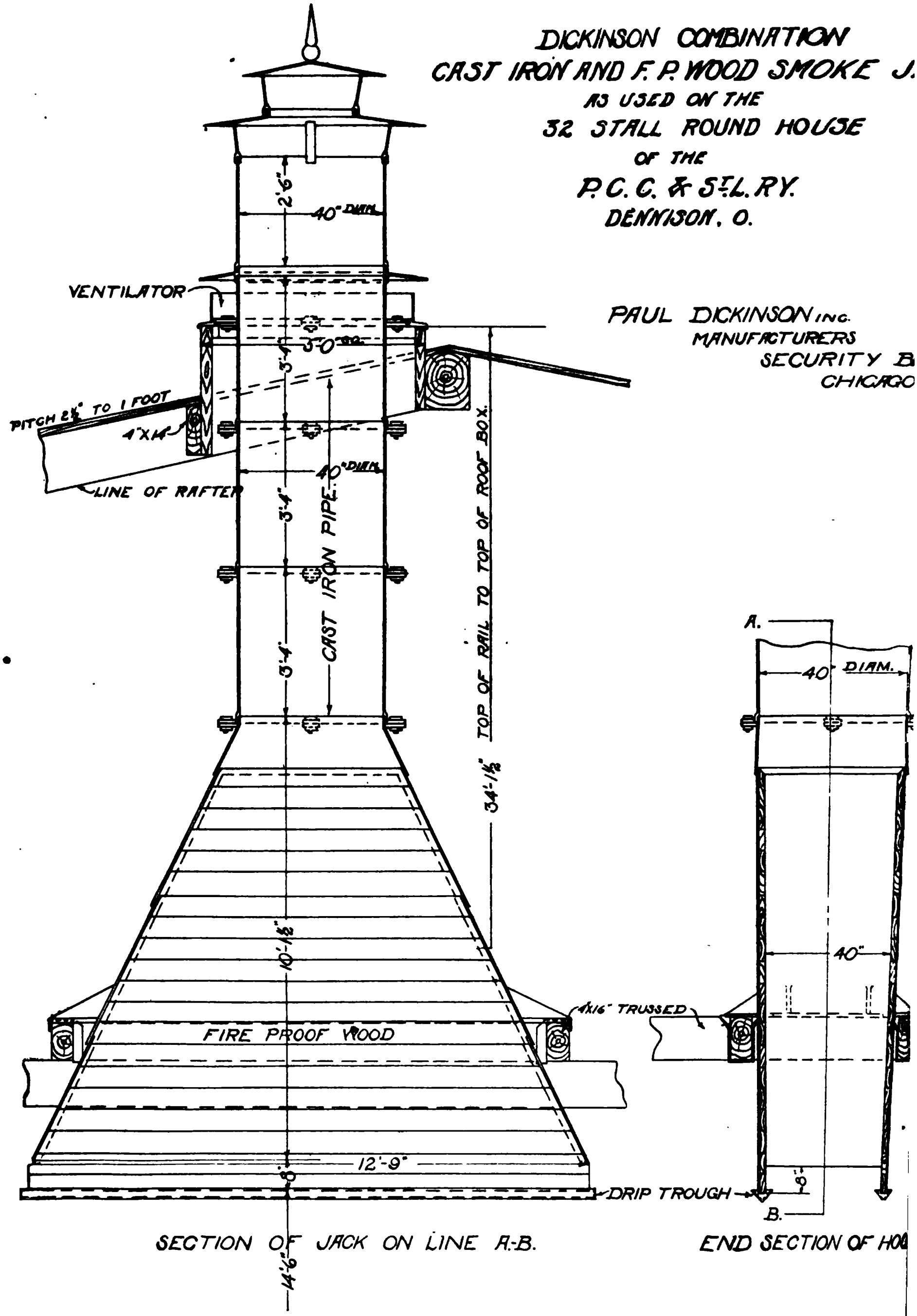


FIG. 51.—Dickinson Combination Cast Iron and Fire Proof Wood Smoke Jack.

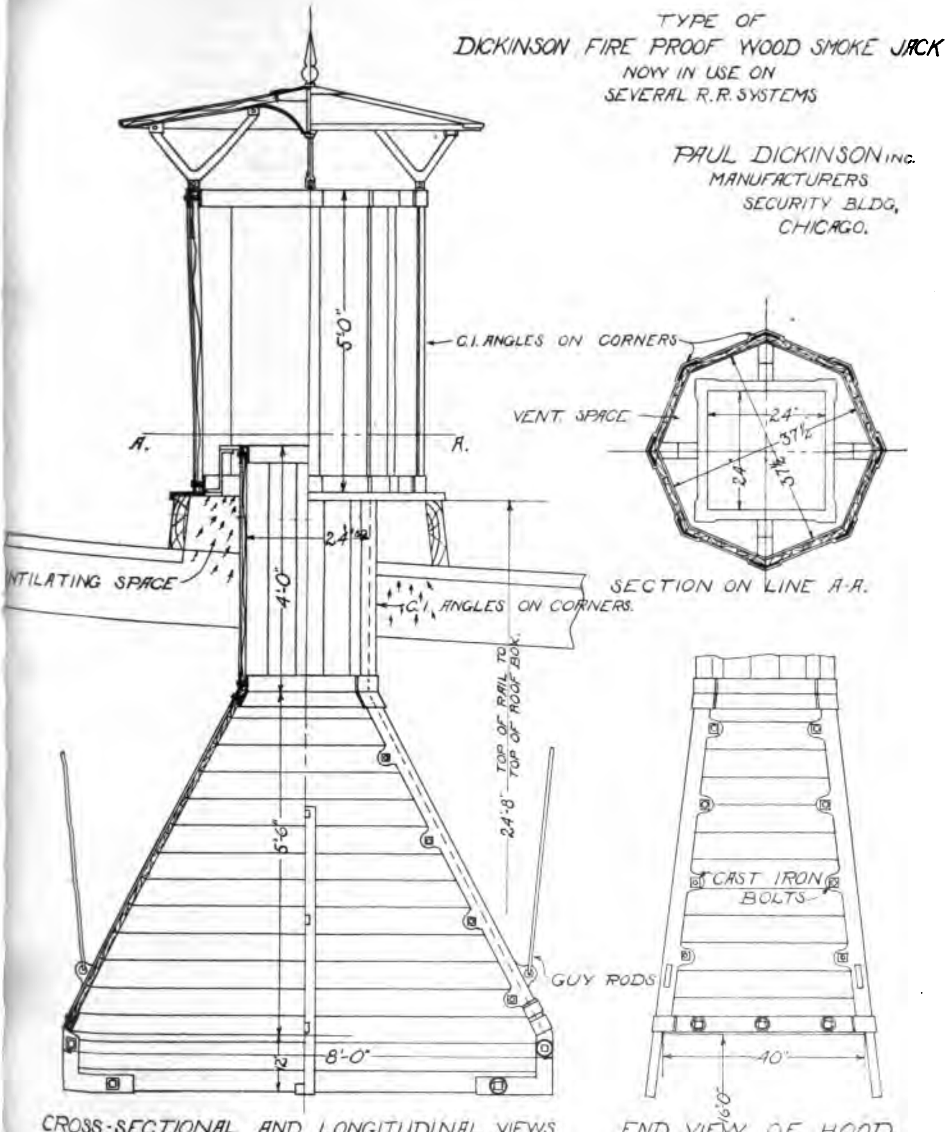


FIG. 52.—Dickinson Fire Proof Wood Smoke Jack.

to pieces in time. Dickinson cast iron jacks are lasting pretty well but they are too expensive if large and high enough to be efficient. Pickring wooden jackets have been used by us extensively but fall to pieces quickly, even when fastened with brass screws. We have four houses with asbestos jacks. These are doing fairly well but have been in service only about two years. I anticipate early falling to pieces where iron is used for connections or support. It is generally conceded that transite is not so durable as asbestos lumber. We are now trying wooden jacks, the stack of which is made of staves secured by hoops. We are not putting any cover over the tops of these jacks but I think that a cast iron damper should be used in them to retain heat when not used as a chimney. These have not been used long enough to give results. I think the Dickinson treated wood jack may show good results if they do not get too much iron into it or make it too expensive. The Pickring jack has given us but little trouble from causing fires, although the insurance people are averse to it. The first thing that fails on these jacks with us is the canopy over the top of stack.

The Chicago, Lake Shore & Eastern Railway has recently had an engine house at Gary, Indiana, equipped with twenty transite asbestos smoke jacks, which are illustrated herewith. The chief engineer of that road says: We have not had these jacks in use long enough to say how they will last, but from the experience of a number of railways which have given them several years' trial we think they will prove to be satisfactory. We have tried the wooden jacks and they have given very good service, but they are dangerous on account of fire. The transite asbestos jacks, as shown on the plan, are made up in sections and bolted together with five sixteenths inch bolts. The heads and nuts of these bolts should be covered with asbestos cement in order to protect them from gas and smoke. The jacks referred to are fourteen feet long, but I think a jack ten feet length of opening at bottom should be sufficient for ordinary use. These jacks cost about twice as much as wooden jacks, but in the long run they ought to represent good economy.

A representative of the Chicago & Northwestern Railway last year made mention (page 208) that they were equipping several houses with transite board jacks; some of the jacks being built of wood, lined with the composition board, others built entirely of the composition material. While these have been in service only about a year, some of them are already in poor condition and are failing in several respects. There is a manufacturers' guarantee upon these jacks, covering a period of ten years from the time of being installed.

Committee {
C. A. LICHTY,
J. P. CANTY,
H. D. CLEAVELAND.

DISCUSSION.

Mr. Steffens.—One of the troubles in a roundhouse is the blowing off of steam rather than the blowing off of smoke. Some modern roundhouses carry off the steam in pipes. There is in existence a system in which the steam is blown from the engines into tanks in which the water contained surrounds another tank filled with pure water used for filling the engines. In this way hot water is obtained for washing out and filling boilers. The patents covering this comprise the Miller system. This subject was discussed at the last Master Mechanics' convention, from the Proceedings of which further details may be obtained.

President.—While the details of this might strictly concern the master mechanics I believe that we are directly interested in preserving the iron in roundhouse roofs as best we can.

Mr. Steffens.—May I ask the opinion of the members present as to whether they prefer a large or small smoke jack. I am in favor of the type that allows an engine considerable movement while still remaining under the jack.

Mr. A. S. Markley.—The atmosphere governs the conditions in reference to preventing smoke from accumulating in engine houses. Under some conditions smoke would hang over the house almost as dense as if there was no roof over it. Where weather conditions are favorable an ordinary jack thirty-six inches in diameter in each stall and similar ventilation in center of roof of every other stall will take care of all smoke, etc. Too much ventilation carries off too much heat in the winter time, making it impossible to keep houses warm and prevent freezing. This, however, will not take care of engines blowing off steam in the house preparatory to washing out. Gas pipe should extend through roof over each stall, to which hose could be attached from dome of engine to carry steam to the open air, or some more improved method should be used to prevent this practice, which damages engine house more than any other cause. While steam is allowed to remain in the house it prevents men from working to advantage, and is injurious to their health. The dripping of condensed steam from the roof makes it more injurious to them, and also rusts off the nails and expands the sheathing, destroying the walls and the felt roofing.

Mr. Steffens.—The conditions that Mr. Markley speaks of can be taken care of by the hot air system of heating and ventilating, by which means the vapor will rise and find its way through the smoke jacks. That is a recommendation in favor of the hot air system as opposed to steam heat.

Mr. A. S. Markley.—We have the Sturtevant system in some of our roundhouses, but are bothered in the same way.

Mr. Canty.—From my experience in handling the ventilating plant on the Hoosac tunnel it has occurred to me during the past year that perhaps blower ventilating arrangements on the roofs of engine houses might be good things if they could be provided. This is only a suggestion on my part, and possibly an idle one, but they might be, however, more effective than any of the smoke jacks we have now in use. Smoke jacks having only a natural draft are not always effective. Perhaps blowers would be an improvement.

President.—Is there any further discussion on this? If not we will pass to the next subject, which is number one of the standing subjects.

PILE AND FRAME TRESTLE BRIDGES.

(Standing Subject No. 1.)

REPORT OF COMMITTEE.

To the Association of Railway Superintendents of Bridges and Buildings:

As it was impossible to have a meeting of the committee, a letter of inquiry was sent to each member, asking for his views on the kind of a report to be made and what questions they would favor investigating.

On January 25th a circular letter was sent to one hundred members of the Association, as follows:

1. Do you use any device to fasten the rail to the tie other than the common track spike, and with what success?

2. Do you use any device to prevent rails creeping, and with what success?

3. Do you use a metal guard rail of any kind, if so please describe?

4. What do you consider the best span length to use?

5. What do you consider the best kind and size of timber to use for the following members: Caps, stringers, ties and piles?

6. What do you find to be the average life of the above members with or without preservative treatment?

7. Have you used any concrete piles, if so please give method of making and driving?

From these letters 27 replies were received and the answers to the questions tabulated. As but one of the members of the committee answered the letter, your chairman does not feel justified in setting down any conclusions as recommendations of the committee, but thinks that printing several of the replies, together with the plans sent in, and setting down his personal conclusions wherever he was able to draw them, would bring out an interesting discussion, and that the Association might adopt any that they considered good.

To question number one there were 27 replies; 22 of the roads use nothing but the spike, and five roads use tie plates in connection with the spike. As on all bridges of this class, the ties are spaced close together, and generally are of selected timber, and as the tie plates tend to develop a split in the ties, their use does not

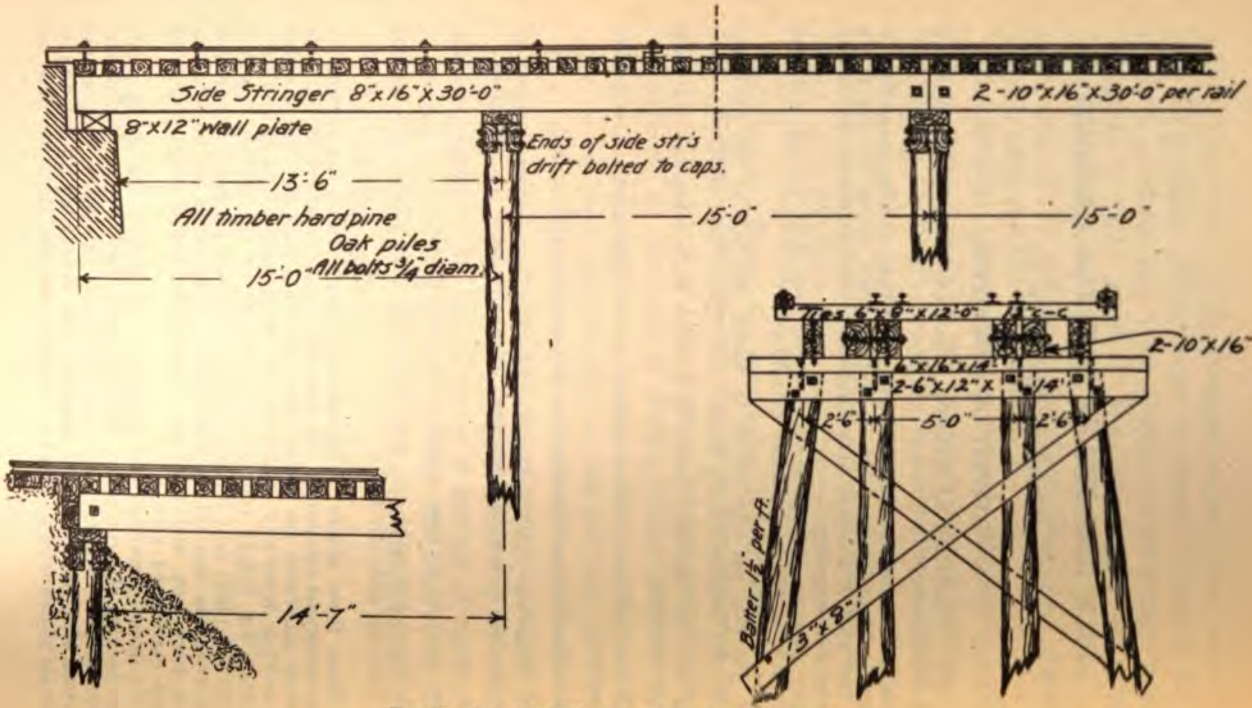
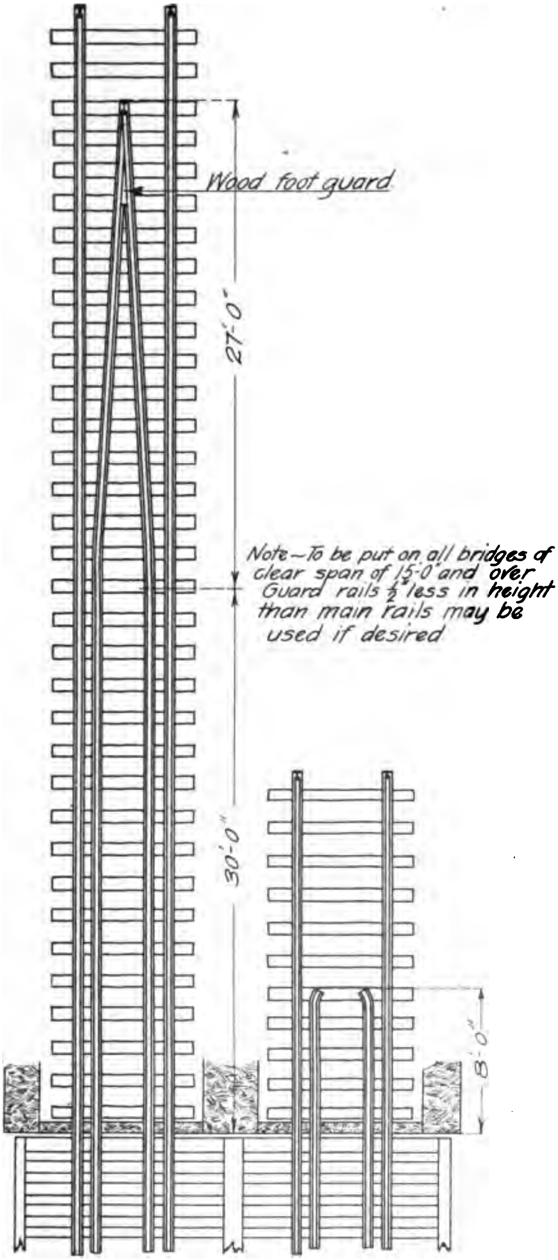


FIG. 53.—Standard Pile Bridge, Boston & Maine R. R.



Note—To be put on all bridges of clear span of 15'0" and over
Guard rails ½" less in height than main rails may be used if desired

FIG. 54.—Metal Guard Rails, Boston & Maine R. R. and Lehigh Valley R. R.

seem to be the best practice. The best practice seems to be that of spiking the rail directly on the ties, and especially avoid spiking through the holes in the angle bars. It would undoubtedly be of great benefit if some of the members of this Association would experiment with some other form of fastening than the spike, such as the lag screws, or bolts, used abroad, and which are supposed to be far less destructive to the tie.

To question number two there were 27 replies; 23 of these report that no anti-rail creeping device is in use on their roads.

One road uses blocks between the ties and spikes the angle bars to the ties and to the blocks with good success.

One road uses the L. & S. rail anchors with good results.

One road slants the spikes in the fish plates.

From the replies it would appear to be the best practice not to attempt to hold the track from creeping on these structures, but if the movement is enough to warrant it, to use some device to prevent it on the approaches to the structure.

To question number three there were 27 answers; nine of the roads reporting use no metal guard rails on this class of structure; 18 of the roads use "T" rails, usually the old track rails and somewhat lighter than the traffic rails. These rails are spiked to the ties at a distance varying from six to ten inches on the various roads.

From the replies it would seem to be the best practice to use a metal guard rail; if no specially designed rail is used, old rails spiked inside the traffic rails, and terminating in an old frog point in the center of the track against approaching trains may be used. This point should be placed far enough from the end of the bridge so that the rails will not converge too rapidly. On the approach in the direction of traffic the point may be omitted and the rails terminate a short distance from the end of the bridge. On single track roads there should be a point on each approach.

To question number four there were 25 replies, the span length used varying from 12 to 16 feet, with an average of 13-feet, 6-inches.

The replies to question number five will be taken up separately:

Caps: The sizes used are as follows:

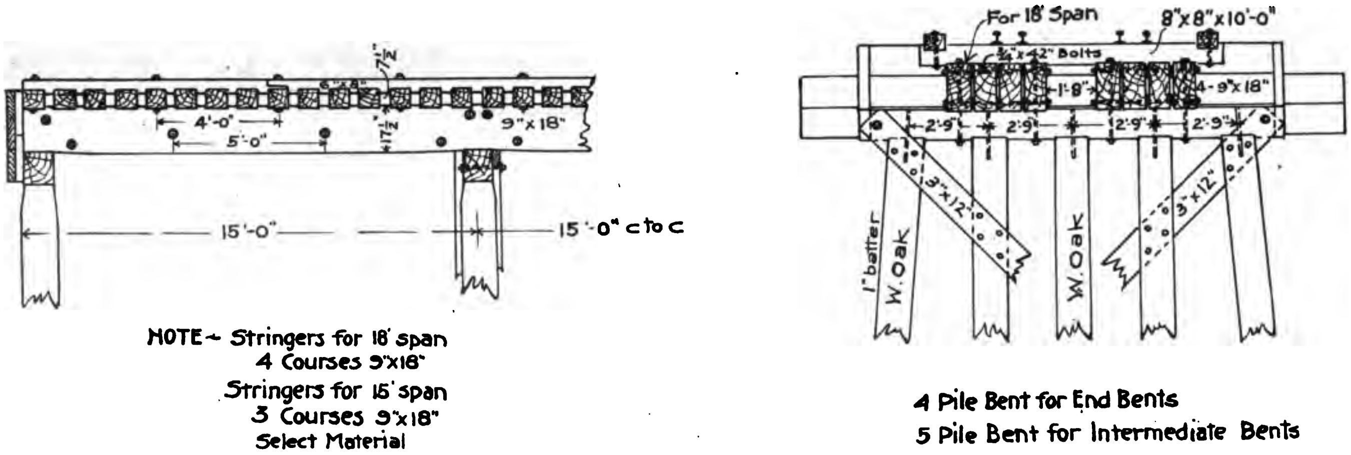
Twelve inches x 12-inches x 14-feet; 12-inches x 12-inches x 20-feet; 12-inches x 14-inches x 12-feet; 12-inches x 14-inches x 14-feet; 12-inches x 18-inches x 16-feet; 14-inches x 14-inches x 12-feet; 14-inches x 14-inches x 14-feet; 14-inches x 14-inches x 16-feet.

One road uses a double cap consisting of two pieces, 6-inches x 12-inches, with a 6-inch x 16-inch rider; this plan is shown by a drawing. See Fig. 53, Boston & Maine R. R.

The material used is long leaf pine on 13 roads; douglas fir on nine roads; oak on two roads; white pine on one road.

The average life is as follows:

Long leaf pine, from 12 roads, 10 years.
Douglas fir, from eight roads, 10 years.
White or burr oak, from two roads, 11 years.



Standard Pile Bridge

FIG. 55.— Lake Shore & Michigan Southern Ry.

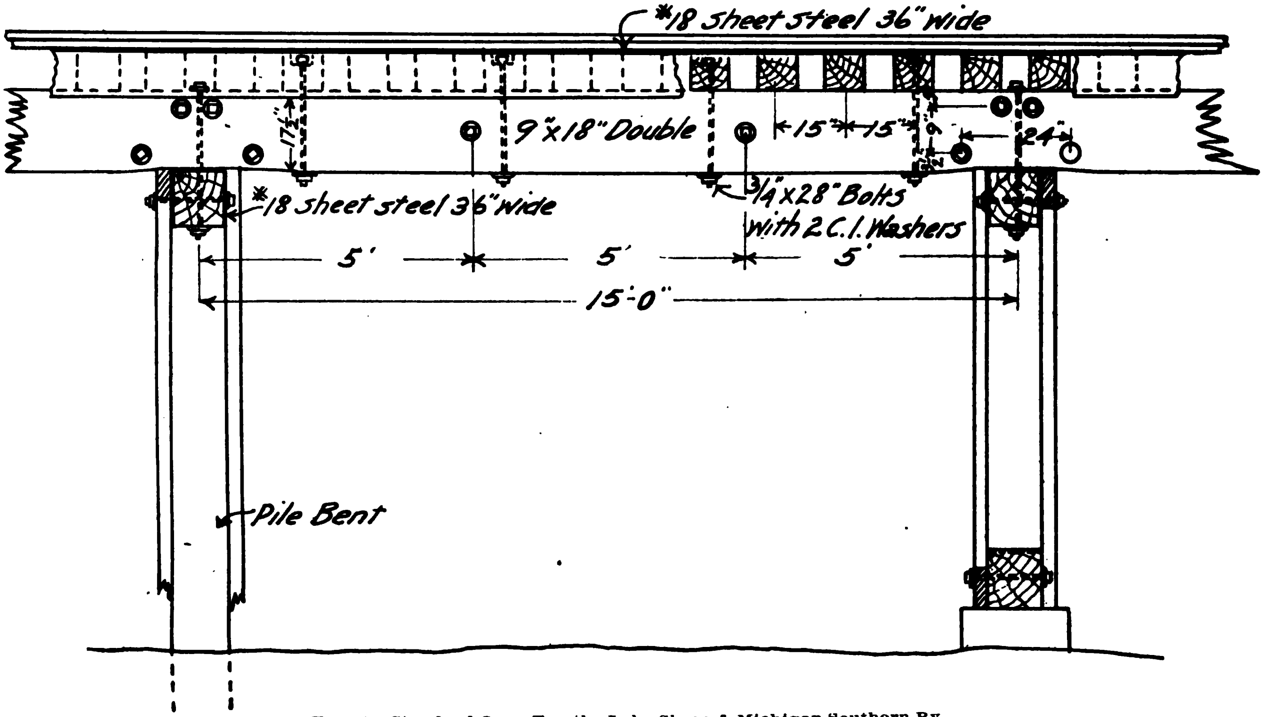


FIG. 56.—Standard Open Trestle, Lake Shore & Michigan Southern Ry.

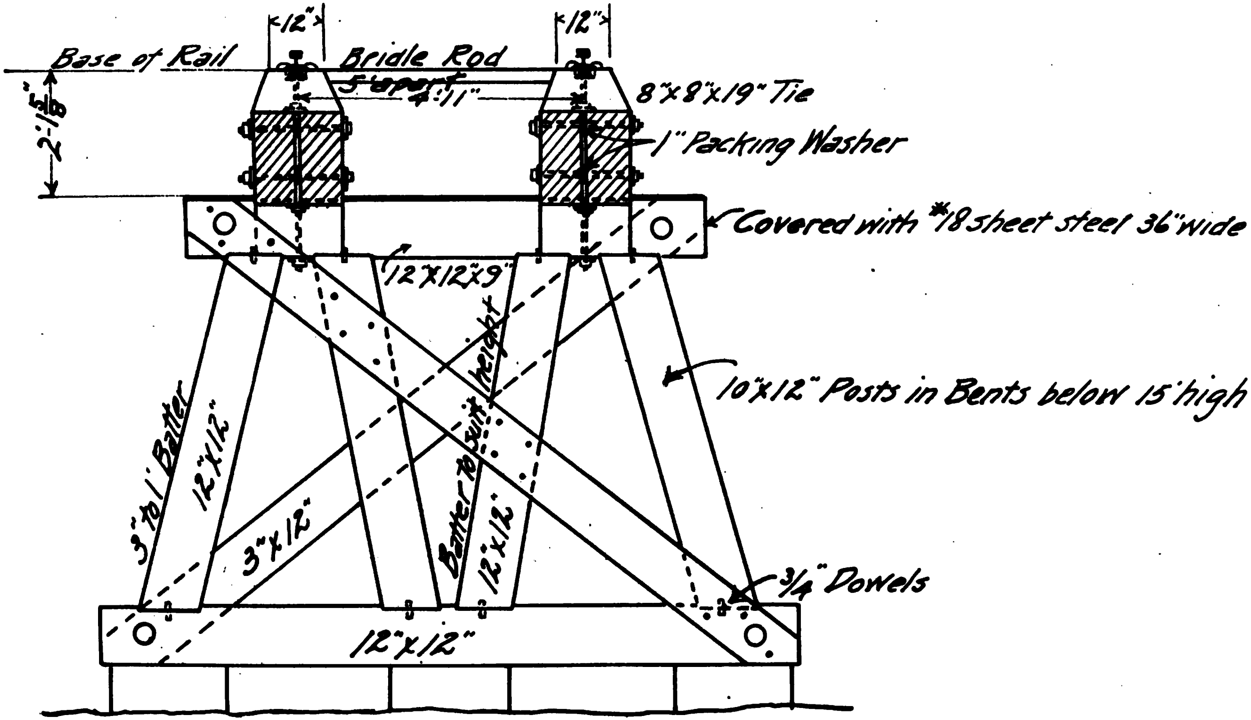
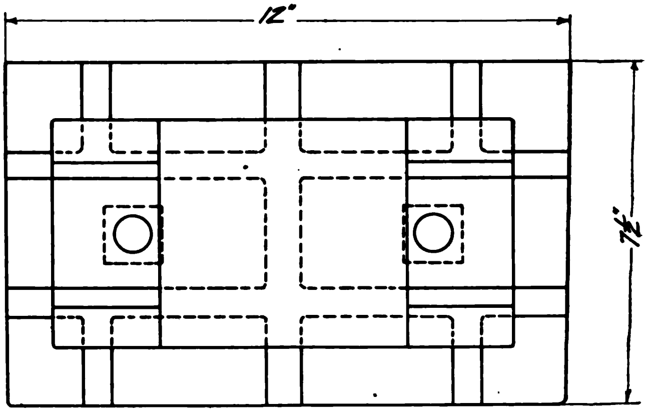
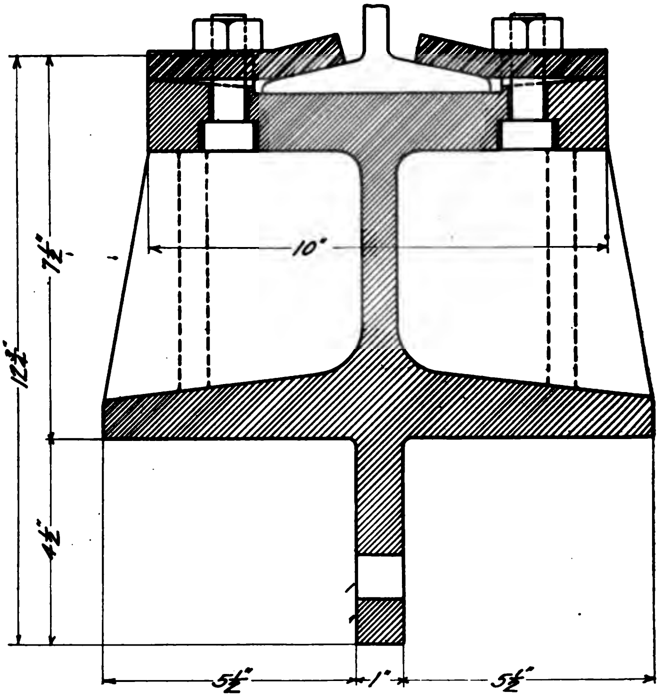


FIG. 57.—Standard Open Trestle, Lake Shore & Michigan Southern Ry.

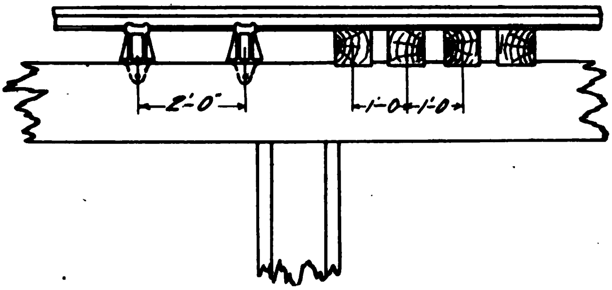


Top View

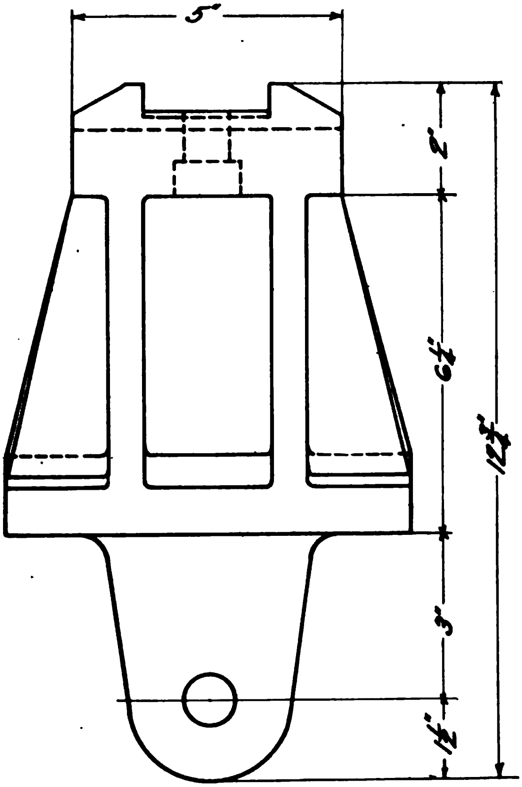


Section.

Fig. 58.—Standard Cast Rail Chair for carrying rails where ties are not used, Lake Shore & Michigan Southern Ry.



Sketch showing location of chairs and Ties



End View.

Fig. 59.—Standard Cast Rail Chair for carrying rails where ties are not used, Lake Shore & Michigan Southern Ry.

One road uses galvanized iron covers over a long leaf pine cap and reports a life of eight to ten years. As this is a southern road where the life is usually shorter, this may be an advantage.

Stringers. The sizes used are as follows:

Seven inches x 15-inches; 7½-inches x 15-inches; 7-inches x 16-inches; 8-inches x 16-inches; 8-inches x 17-inches; 8-inches x 18-inches; 9-inches x 14-inches; 9-inches x 16-inches; 9-inches x 18-inches; 10-inches x 16-inches; 12-inches x 14-inches; 12-inches x 16-inches.

Nearly all the roads reporting agree on using continuous stringers over two spans.

The material used is long leaf pine on 13 roads; douglas fir on 10 roads; white oak on one road; white pine on one road.

The average life is as follows:

Long leaf pine, average from 13 roads, 10 years.
Douglas fir, average from 10 roads, 11 years.
White oak, average from one road, 10 years.
White pine with iron cover, one road, 14 years.

Ties: The sizes used are as follows:

Six-inches x 8-inches x 9-feet; 6-inches x 8-inches x 12-feet; 7-inches x 8-inches x 10-feet; 7-inches x 9-inches x 9-feet; 8-inches x 8-inches x 9-feet; 8-inches x 8-inches x 10-feet; 8-inches x 10-inches x 11-feet; 8-inches x 8-inches x 12-feet.

The material used is long leaf pine on 10 roads; douglas fir on five roads; white oak on four roads.

The average life is as follows:

Long leaf pine, average from 10 roads, nine years.
Douglas fir, average from four roads, 12 years.
White oak, average from four roads, 10 years.

Piles: The material used is white or burr oak on 12 roads; white cedar on seven roads; creosoted pine on three roads; red cedar on two roads.

The average life is as follows:

White or burr oak, average of 10 roads, 10 years.
White cedar, average of six roads, 17 years.
Red cedar, average of two roads, 12 years.
Treated pine, average of two roads, 14 years.

Conclusion:

The two species of timber in general use for caps, stringers and ties are douglas fir and long leaf pine.

The replies do not indicate that there is any great difference in the behavior of the two in these structures and that, therefore, each road should use the one that can be secured at the least cost. The other species of timber used for these members do not seem to have advantages enough to overcome their cost and scarceness; the possible exception being the use of white or burr oak for caps, due to the high resistance to crushing. It is probable that good results can be obtained by the use of the cheaper pines by using some preservative process.

It would doubtless be of great advantage if the designers of these bridges could get together and adopt uniform sizes and lengths for these members. If that were done these timbers could be cut in large quantities, and treating plants could season and treat them with the certainty of a demand for them. Possibly each class of track adopted by the maintenance of way association could have a separate plan.

For piling the better species are becoming too scarce to supply the demand, and as they are of extremely slow growth, use will have to be made of the cheaper grades treated. The government forestry bureau states that it takes 190 years to grow a white cedar large enough for a telegraph pole, and the northern white and burr oak are of very slow growth, so that when forestry is relied on to meet the demand, the quicker growing trees will have to be planted.

To question number seven, replies were received from 26 roads, none of which have ever used a concrete pile in the class of structures under discussion.

H. M. TRIPPE,
Chairman.

(No discussion.)

FIRE PROTECTION.

(Standing Subject No. 2.)

REPORT OF COMMITTEE.

To the Association of Railway Superintendents of Bridges and Buildings:

Your committee on standing subject number two, "Fire Protection," beg leave to submit the following report:

After sending out circular letters and receiving nearly one hundred replies, we think best to embody a number of the replies in our report, which we will give first and then follow with a synopsis of the balance of the reports.

We also present a limited number of drawings, to which we call attention, as each drawing contains some practical idea on the subject. We also call special attention to the circular letter issued by the Southern Pacific Railroad on this subject; also the very extensive description of the appliances of the Boston & Maine Railroad, at the Mystic and Hoosac docks at Charlestown, Massachusetts. This particular paper we beg leave to have printed in full. It is quite elaborate but at the same time full of practical ideas for protection at less important buildings.

We desire to impress upon the minds of all concerned that there are two important features of fire protection, in addition to providing proper facilities and equipment.

First, That the equipment be properly cared for after it has been installed, as it would be useless otherwise, and that men directly connected with the equipment be drilled intelligently.

Second, That all parties interested, work together in keeping the premises and buildings clear of worthless combustible material. We believe that more fires are caused from the accumulation of worthless trash of various kinds than many realize.

J. M. Wells, General Foreman Bridges and Buildings, and Water Supply, Atchison, Topeka & Santa Fé Railway:

For shop protection we have regular standard fire plugs at convenient locations, have a hose shanty with a stationary hose reel in it and 150-feet of Standard fire hose on the reel, also a hose pipe. We also have a hose cart with at least 400-feet of hose on it. At all times the tank pressure is on the fire plugs, this to use until we can start the pumps in the shops or houses, whereby we can increase the pressure to at least 100 pounds at the nozzle, and when possible we also connect with the city water mains and use city pressure if a fire is of such nature that we cannot use our own pumps. Our forces are drilled at the shops and are supposed to drill once a month.

In our freight houses we run a main the full length of the house, have stand pipes one hundred feet apart, with fifty feet of standard hose coupled on to the stand pipe, keep the hose on a reel, have a hose pipe on each piece of hose. We also have three gallon buckets filled with dry sand placed on shelves at convenient places, as sand is a good fire extinguisher for a small fire.

Coal stations same as shops, except we use water barrels and fire buckets placed at convenient places.

At our small elevators we use water barrels and buckets. At our large elevators we use an automatic sprinkling system with a tank pressure that acts immediately when a fire starts in any part of the building and burns or melts a fusible wire. The tank pressure is for an initial pressure until the pumps can be started. Pumps are in a detached building and flood the interior of the work house. Our storage bins are of concrete and are fire proof.

For depots and storage sheds we use water barrels and buckets, also dry sand and hand extinguishers.

We have a three-gallon chemical extinguisher which is all right for a small fire.

For bridges we use water barrels and buckets, also cover the chords and caps on trestle bridges with No. 26 galvanized iron; have had good results from barrels and buckets; would recommend No. 22 iron for trestle bridges, as No. 26 is too light, does not stand the wear long enough.

As to any other methods, I think we cover the ground pretty thoroughly, as the insurance inspectors are satisfied. The main thing is well drilled men and quick action when a fire starts, else no apparatus amounts to anything.

W. M. Clark, Master Carpenter, Baltimore & Ohio Railroad:

We have in the shops a regular organized fire brigade, with full corps of officers, and have fire drills regularly each week and in addition have emergency calls, which are liable to happen at any time and are called at the will of the master mechanic, general foreman and fire chief. Each shop is provided with as many fully equipped hose houses as is necessary to fully cover the entire plant; have no regularly installed fire alarm system, but all parts of the shops are connected with engine house by telephone and each hose house is numbered. The engineer in charge attends to all details in the engine house. His first duty is to blow the number of the house nearest to the fire and see that every facility is given to the fire service. A part of his duty each day is to inspect and keep in repair all hydrants, hose and hose connections and see that all necessary tools are in their proper place.

All freight and passenger stations in towns or cities that have city water are provided with fire hydrants and hose, and the employees are trained weekly, and in addition all freight and passenger stations are equipped with water barrels and water pails placed in locations of easy access, and barrels and pails are kept constantly filled ready for instant use.

If coaling stations are in connection with shops, the same pro-

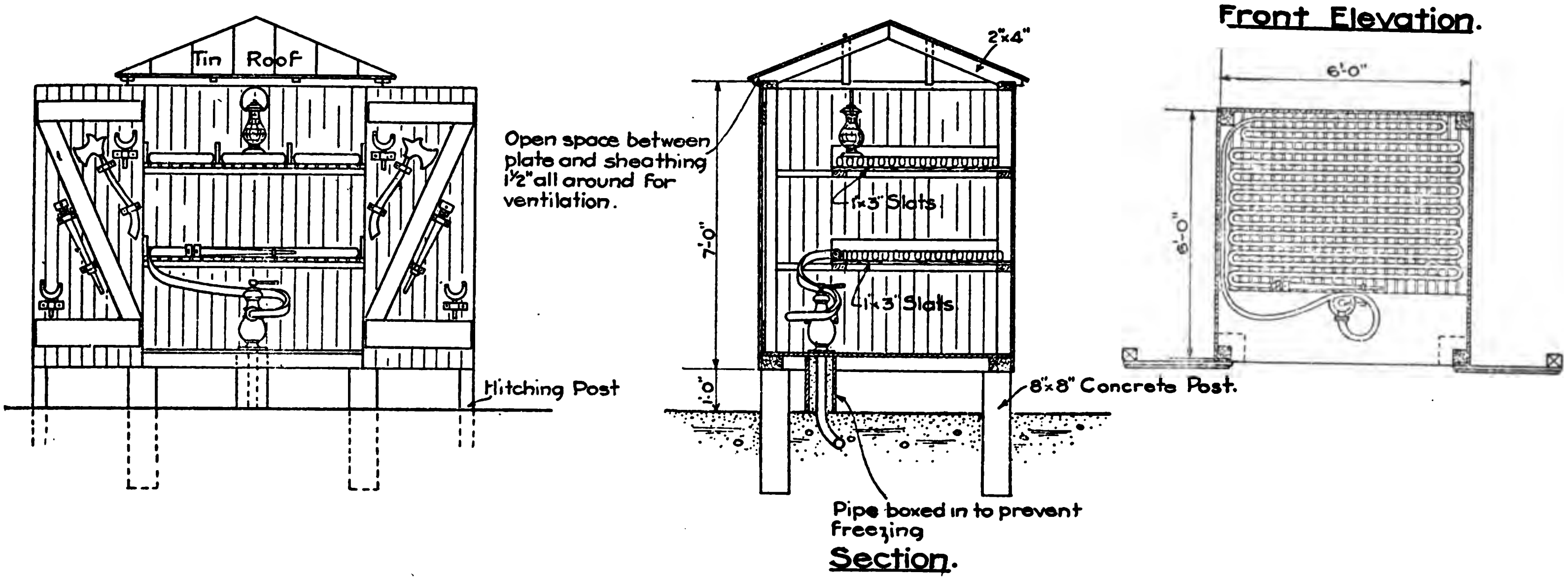


FIG. 60.— Fire Hose House. B. & O. R. R.

NOTE.-- In order to close doors without bolting on inside or having upright post in center of doorway, a long latch of 2 in. x ¼ in. iron to be loosely bolted to one door and dropped into catch on other door. Long latch to have handle to lift it out of catch. No locks or bolts to be used.

tection as shops is used in coal tipples, and in addition barrels and pails are used.

Elevators are protected by the regular fire system, operated by employees, who are trained each week, and in addition thereto they are protected by a sprinkle system which covers the entire inside of building, each 10-feet square being provided with a sprinkler head. This system is attached to an 80-barrel tank on the roof. As soon as the fuse is melted out and the sprinkler goes to work, the reduced pressure, in addition to turning the water on from the tank, starts the fire pump and by an automatic arrangement blows the whistle. On warehouses and docks we have the regular fire system, and in addition, water barrels and pails filled with water are distributed in all parts of the buildings.

In other buildings we protect by water barrels and pails and fire extinguishers. No buildings are left entirely without fire protection.

We use the Babcock and Childs fire extinguishers, and find them effective if kept in proper condition, but all chemical extinguishers must be charged at least every six months and sometimes oftener. I would, however, rather depend on the water barrels and pails than on chemical extinguishers.

Protection for bridges and trestles is by a plentiful supply of water barrels, one sunk in the ground at each end of the bridge, and where bridges are over 100 feet in length a sufficient number are placed on the ends of caps on wooden trestles and on chords of bridges. Each barrel is fitted with a cover and an old powder can hung on a nail in top of barrel and sunk in barrel. We have had several occasions to use this fire protection and are convinced that if we had not had the barrels and pails the bridge would have been either entirely destroyed or at best severely damaged.

I know of no other method of fire protection that I consider better or even as good as the methods used by our company, who, though their insurance department is continually devising methods to lessen danger of destruction by fire, train all employees to use every endeavor to guard against fire by seeing that their appliances are in first class condition and also to keep the premises clean from rubbish, refuse, waste papers and inflammable material, which I think is as necessary a protection from fire as the fire fighting appliances themselves.

One of the most necessary things in prevention of fire is prudent caretaking of the property.

John A. Rhoads, Fire Inspector, Chicago & Northwestern Railway:

At the more important shop plants, where we have adequate city or private water supply, and efficient pressure, our inside buildings are equipped with 2-inch to 3-inch pipe, and provided with 1¾-inch hose. For outside protection we have regulation water mains, ranging from 3-inch to 6-inch, fitted with standard fire hydrants, and equipped with regulation 2½-inch fire hose. We aim to use the same type of hydrant as is adopted by the city. Where we do not have city mains or city protection, we depend on regulation washout pump connected up to washout system, and so regulated that it can be cut in on independent fire line. At the smaller outlying roundhouses, where we do not have city protection or washout systems, we depend on water barrels for emergency protection. At our Chicago shops, the largest on the system, we have a private Gamewell fire alarm system, with boxes scattered through the plant, connecting with main power house. Alarm to city fire department is turned in from main power house. At other important points where city maintains fire alarm system we have city box located either in power house or in close proximity to plant. At all important points, men in charge are organized for fighting fire and drill once a month.

In our important freight stations, the buildings are equipped with 3-inch pipe, and provided with regulation 1¾-inch hose, and regular fire drills are held once a week. Some of our modern passenger stations are equipped with small chemical extinguishers, but in the main we depend on city protection. Our small country stations depend almost entirely on barrels and pails for emergency protection.

Where our coaling stations are located close to shops or water tanks, and where adequate water supply can be obtained. we pipe water up into the chutes and provide small 1¾-inch hose. At the majority of our coaling plants, however, we provide water barrels and pails.

In our important terminal elevators we have regulation hose and hydrants in the building, with adequate water barrels scattered throughout the structure. Our docks are protected by complete pipe line systems, equipped with 2½-inch fire hose, and in some cases with manual sprinklers. We also maintain continuous watchman service. At such points as do not provide city water supply and pressure, we maintain independent fire pumps and pipe lines.

For the general run of smaller buildings at outlying points, we depend on water barrels and pails for emergency protection.

At a very few points we use small size chemical extinguishers, and at all interlocking plants we use small bottle extinguishers, manufactured at our laboratories. The occasion for their use has been so limited that statistics as to their reliability are wanting.

For bridges and trestles we depend on water barrels. In numerous instances their value has been demonstrated, but on other occasions we have suffered loss on account of the absence of employees at time fire started.

The matter of protection of high coal chutes is one that might be discussed. Water pipe and hose afford adequate protection during the summer months, when the water can be turned on, but during the winter months this method is not reliable and dependence has to be placed on water barrels and pails.

F. E. Schall, Bridge Engineer, Lehigh Valley Railroad:

The shop buildings are generally equipped with regular water supply system. Branches from the mains lead to the inside of buildings, where hose connections and coils of hose are supplied ready for an emergency. Hydrants are also on the outside of the buildings for hose connections, placed at regular intervals to reach the buildings. The fittings are all arranged so that the city or town fire hose can be attached when necessary. Each shop is organized to fight fires, and regular drills are had at stated intervals, say once in two weeks. Hose carts are also provided at the larger plants to move hose quickly to buildings, etc., on fire.

For passenger and freight stations where water is provided we have in general use hose connections on stand pipes located in waiting rooms, hallways, baggage rooms and other accessible places, provided with globe valves, operated by a hand wheel, 2½-inch linen hose, in lengths varying from 25 to 75 feet. The hose is generally placed on hose reels. In addition to this, chemical extinguishers, buckets, etc., are provided in some places. In case of stations not provided with water pressure, we have to depend entirely on chemical extinguishers and water buckets. In freight stations the same general rule is followed, substituting hydrants for stand pipes, and in some cases an additional protection of sliding fire doors (operated by a fusible link) placed in brick or concrete fire walls, dividing the building into sections, are provided. Generally fire doors are placed between the freight room and the offices. Where there is a city fire department there is generally a fire alarm box placed either in the building or adjacent to same. It is also customary to place fire hydrants in freight yards near buildings. At our Lake freight houses in Buffalo, hose carts and a chemical engine and a private alarm system leading to pump house are provided. No sprinkler system has been provided except in the large freight warehouses on wharves at Jersey City.

At coaling stations where water pressure is available, hydrants have been provided in yards, and in some cases stand pipes leading to top deck of coaling station. These stand pipes are dry pipe, with reap valves at ground line. Hose on reels are also provided. In addition to these, barrels, buckets, chemical extinguishers, etc., are made use of. Where yard hydrants are used, it is customary to have hydrant keys, hose, nozzles, etc., in a covered box alongside of hydrants. At coal shipping piers at Perth Amboy, New Jersey Terminal, there is a dry salt water system pipe line connected with a central pumping station, with mains leading to hydrants and stand pipes on wharves. The equipment consists of hose carts, barrels, buckets, chemical extinguishers, etc. There is also in service an electrical alarm system, with boxes at each shipping pier or other available place, registering at the pumping station, where there is an alarm whistle. There is also a city alarm calling out the city fire department. The fire force is under the general supervision of a chief and the men divided into squads under their foreman. Regular stated fire drills, both by day and night, are had every two weeks, and when an alarm is sounded each man reports at the proper station appointed to him during the drills. Test alarms are sent every day from some point on the terminal to see that the alarm system is in working order. These test alarms are answered by the whistle at the pumping station. There is no connection with the city mains at this point.

At the Lehigh Valley Railroad terminal at Jersey City, N. J., freight piers and pier warehouses, there are two distinct fire protection systems, a fresh water system connected with the city mains and a salt water system operated from a pump in the central pumping station.

In connection with the fresh water system there is provided a 50,000-gallon water tank on an 80-foot tower connected to an automatic Esty sprinkler system. Each pier, in addition, is provided with hydrants, hose, buckets, axes, hooks, etc. (about 150 filled buckets are placed in each covered pier). The systems are so arranged that salt water can be pumped into the fresh water main and to the sprinkler system, if at any time the fresh water supply should be cut off.

The fire fighting equipment at this point consists of one chemical engine and eight hose carts in small houses along the bulkheads adjacent to the piers.

Alarms are sent by a private electric alarm system, with boxes located at each pier or warehouse on pier operating a series of fire gongs and also registering at pumping station, where there is an alarm whistle sounding the number of the box from which the alarm is turned in. In addition there is an alarm calling out the fire-fighting tug boats. In connection with this, city fire alarm boxes are placed at regular intervals along the line of piers.

The fire-fighting forces are under the direction of a paid chief and consist of the entire working force of men employed at the piers and sub-divided so that each gang is controlled by its foreman, who is directly responsible to and receives orders from the chief. In case of an alarm each man at once reports at the station which has been allotted to him during the drills, such as hydrant men, engine men, hose cart men, etc. Practice drills are held every two weeks, both day and night drills.

Test alarms are sent at certain intervals to ascertain whether the alarm system is in working order. At the pier warehouses in New York City the equipment consists of hydrants, hose carts, hose buckets, etc. Water is taken from the city mains, and city and fire boat alarms are located at or near the piers and warehouses. Regular drills are had every week. At the national stores, L. V. R. R., Jersey City, N. J., two systems, fresh water and salt water, are provided. The fresh water is supplied by the city system and the salt water by a pump located on the property. A 50,000-gallon storage tank on a steel tower is also provided.

Hydrants are provided on each system at regular intervals and inside of the frame-covered pier a system of mains are run around the inside face of the four walls, with valve outlets placed near the doors. In these covered piers from 300 to 650 lineal feet of 2½-inch linen hose has been provided, according to the size of the pier.

At the brick warehouses there are standpipes leading from the ground to the roof on outside of building, with Siamese hose connections at the ground and Siamese Goosenecks at roof line. There are two standpipes to each building, with connections leading to the inside of each floor with 150-ft. of 2½-inch hose connected thereto.

On each floor are four filled water barrels and fire buckets, chemical extinguishers, etc.

The equipment here consists of ten hose carriages, with 350-ft. hose each and one chemical engine.

The elevator at the national stores (L. V. R. R.), Jersey City, is protected by a sprinkler system placed on the roof, supplied through a 6-inch pipe with valve near the ground. This main is connected with the salt water system and is continually under pressure, as well as the stand pipes leading to the several floors.

In case of a fire the sprinkler valve is turned on and the roof flooded. On each floor are provided, for each stand pipe, long lengths of hose on reels, water barrels, buckets, chemical extinguishers, and glass hand grenades in racks at each stairway; regular drills every week and test alarms daily.

The fire chief or marshal at Jersey City Terminal, L. V. R. R., has general supervision of fire protection over Jersey City Terminal, national stores, Perth Amboy and New York terminals of Lehigh Valley R. R.

The chemical extinguishers in use at the various points are Rex, Hollywood, Babcock and the Underwriter. Hand grenades are the Haywood.

F. O. Draper, Superintendent of Bridges, Illinois Central Railroad:

Fire protection consists of a distribution of fire extinguishers according to rules of the underwriters; oily waste cans, where waste is used; all electric light wires in metal conduits, where exposed to mechanical injury; drop cords made of heavy window cord; and metal guards and shades on all electric light globes where needed. We do not use paper globes or hang them against wood.

We use the A. D. T. system of fire alarm, or Newman's watchman's clock system.

Fire companies of eight men are organized and drilled twice each month. We see that the hours between six and seven, both morning and evening, are covered by fire department.

A water barrel and two pails are placed in all freight houses. Where they are larger than 1,000 square feet we place one barrel and two pails to every 1,000 square feet or portion thereof; also one 2½-inch hydrant with 50-ft. C. R. L. hose and nozzle every 150-ft., and place an extinguisher in each waiting room in all passenger stations.

At coaling stations, around any dead space for coal to accumulate, we clean thoroughly every two weeks, place automatic sprinklers and outside hydrants.

Elevators are equipped with automatic sprinklers, automatic journal alarms, water barrels and pails, hydrants and hose; fire alarm system, and night and day watchmen; organized fire department. Docks are covered the same as shop plants.

The Patrol 3-gallon open bottle type extinguisher is used. We have a record of one being recharged six times where a fire occurred, resulting in the fire being extinguished.

A barrel and two wooden pails are maintained at all bridges and trestles up to 70-ft. long; over 70-ft. and up to nine bents one bar-

rel and two wooden pails at each end buried in the ground; all bridges and trestles over nine bents, one barrel and two pails to every 140-ft. This causes a saving of 60% of fire loss. See sketch of pail.

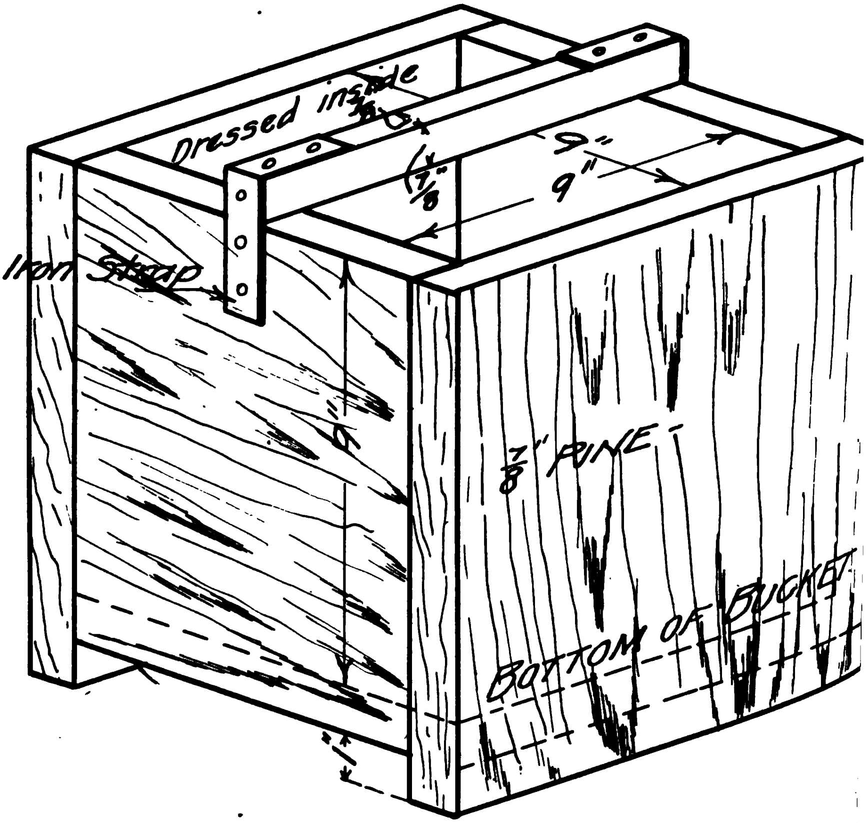


Fig. 61.— Detail of Bucket for Barrels on Bridges or Trestles. Ill. Cent. R. R.

F. B. Scheetz, Engineer of Bridges, Missouri Pacific Railway:

Inside of machine shop, hose reels located 100 feet apart, with 50-ft. of 2½-inch hose. Inside of coach and paint shops, a sprinkling system, which also gives the alarm.

Outside of shop buildings, hose cart stored in a house, with 400-ft. of 2½-inch hose, and water is taken from plugs scattered over the shop grounds, about 400-ft. apart and far enough away from the buildings so firemen can attach hose without harm from the fire. A code of signals from a whistle is used for the various buildings. The men drill once a month. Certain of the men are assigned to "fire extinguishers," others to "nozzles" and others to "hook and ladders."

In small ordinary freight and passenger stations, only fire extinguishers are used. In large freight stations 50-ft. of 2½-inch hose, located 100-ft. apart, is used with city water pressure.

At coaling stations the sprinkling system is used in some of the mechanical stations, and barrels and buckets at other points. No open lights such as torches are allowed in mechanical stations.

For elevators, the underwriters sprinkling system, with stand pipe and hose connections.

For oil houses we use a steam jet.

At one time we used water barrels on all bridges, but have abandoned this practice except on long and high trestle bridges, where water barrels are spaced about 150-ft. apart.

G. Aldrich, Supervisor Bridges and Buildings, New York, New Haven & Hartford Railroad:

I would first state that at our large shops at Readville we have a sprinkler system in all buildings of the car department. This system of pipes runs under the roof on inside of building and on each there is a fusible plug at the end, which melts at a certain degree of heat and the water is then allowed to escape. This is connected with the water pressure and the force of water is such that there are few places in the building which would not be reached by the escaping water.

There is also at this place a hand hose cart in the car department, which is manned by the shop's force, one of whom is appointed chief.

This department is drilled once a week. These shops are also connected with two different town fire departments, with special fire alarm boxes for each.

At Boston, where we have important buildings, all of our freight houses and piers are equipped with standpipes connected with the city of Boston's main. There are four of these standpipes to the average freight house. These pipes have attached to them 50-ft. to 150-ft. (according to requirements) of hose and nozzles.

The valves to these standpipes are all sealed. The order is that they are not to be opened except in case of fire.

There is also distributed around the plant some 200 water barrels and 600 pails, all of which are kept full of water during the warm and mild weather, and the barrels during the cold and wintry weather with a solution which prevents the liquid from freezing.

Babcock and Kilfyre extinguishers are also supplied to the smaller buildings, other freight houses, piers, etc. The barrels, pails, racks, standpipes, etc., are all painted red so as to especially attract attention in case of necessity.

The same system is used in the elevators and on the docks as in the freight houses, with the exception that the elevator, on account of its height, has a pump and boiler with sufficient steam all the time to force water to the top in case of necessity.

We have at this plant three private fire alarm boxes. Connected with these boxes are forty-seven auxiliary boxes, that is, fifteen or so to each city box, by which means fire alarms can be sent in at two places in each house. This system is the Auxiliary Fire Alarm System of Boston. They ring direct through the city box with which they connect, just the same as though the box itself were pulled. In other words, it saves time of going from the nearest box to where the fire is discovered to one of the city boxes, which we would have to do if we did not have the Auxiliary System.

The men are moved from one house to another during every day, in accordance with the demands of the business, so that it is practically impossible to have any fire drill. Complete information, however, as to the fire equipment is furnished the foreman of each of the houses and he in turn furnishes the clerks and subforemen and these men are interrogated from time to time as to their knowledge of the apparatus and its whereabouts, how to use it, etc., and this is believed as far as it is practical to go.

In addition to all this, we have one man called the fire inspector, whose duty it is to go over the plant all the time and do nothing else but inspect the equipment and to see that it is kept in order. He reports all leaks in mains, standpipes or valves, and, with the sanction of the fire department, tests the pipes from time to time. He examines the hose, nozzles, etc., and knows that they are at all times in condition to use. He keeps the fire barrels and pails full during the summer and the barrels full during the winter and knows that the solution is strong enough to prevent freezing.

In case of fire he assumes charge until someone superior in authority appears and until the fire department responds to the alarm and turns same in immediately on discovery of fire, without regard to whether it is large or small.

There is one thing more that is pertinent, at least here, and that is the action of the yard department upon the discovery of a fire. Whistles are immediately blown to warn everyone of the fire and especially in the yard, to pull cars from a house or siding where there may be danger, and to clear the crossings if fire occurs at night to allow the passage of the fire department.

As to the smaller stations, we have water barrels in each room, the number governed according to size, not having barrels over 50-ft. apart.

We also have distributed around the buildings the Kilfyre, Little Giant and Rex fire extinguishers. I know but little about the value of these. I have seen a small fire put out with a Rex, which contains a liquid which is used by turning it bottom side up. Would add that we have fire pails kept with all water barrels.

We have water barrels set down part way into the ground at each end of wooden bridges, and where they are very long we have barrels placed about 150-ft. apart on platforms built for this purpose.

I have seen water from these barrels put out a fire. The great trouble is to keep pails to dip the water with, or have anyone there to dip the water, as many of our bridges are away from any inhabitants, and as a rule the fire would be beyond fire bucket treatment before it is seen, especially on large, old-fashioned Howe truss bridges.

I would suggest that bridges and trestles be whitewashed, as I believe that it is a wood preservative as well as a fire preventative, and I think that this can be economically put on with a sprayer.

W. R. Worthington, Fire Marshal, Pennsylvania Railroad Company:

In our shops we use fire casks and pails, fire plugs, standpipes, fire pumps, portable and stationary hose reels and chemical apparatus in shop buildings. We use the Gamewell Fire Alarm System in larger plants, steam and air whistles in small plants and in passenger and freight yards. Employees organized into volunteer day and night companies, all of which are drilled at least twice each month.

In depots we use fire casks and pails, fire plugs, fire pumps, stand pipes, automatic sprinklers, portable and stationary hose reels and chemical apparatus; also provisions made whereby city departments can attach fire engines and force water into standpipes in freight and passenger stations.

At our coaling stations we use fire casks and pails, fire plugs, standpipes, hose reels and houses on coaling stations.

We use standpipes, hose and chemical apparatus in elevators in buildings.

We use the 6-gallon Babcock and the 3-gallon Underwriter fire extinguishers, with the result that about 75 per cent. of our fires have been put out in their incipiency by same.

We protect bridges and trestles with fire casks and pails and by wrecking and shifting locomotives, which are equipped with fire apparatus, and have had occasions to use same with satisfactory results. However, we protect all bridges and trestles with track watchmen.

I recommend parapet walls in all engine, round or storehouses, paint and repair shops, power and electric plant, the same to extend at least three feet above the roof.

I recommend fire pumps as an auxiliary to gravity pressure on fire plugs at all important plants.

I recommend perforated steam lines, controlled by automatic valves, in all oil houses, paint and buffing shops.

I recommend sand as protection for electrical apparatus, especially switch boards, fuse boxes and convertors.

I recommend fire extinguisher cars at important points.

G. H. Soles, Superintendent Bridges and Buildings, Pittsburg & Lake Erie Railroad:

All our shop buildings are equipped with water plugs and hose of standard sizes, such as are used in the city of Pittsburg. We have no organized fire department. The foreman of each shop makes a test of all plugs and hose once a month and reports same to the master mechanic and in case of fire the whistle on power house is sounded. We also have in our shops the Excelsior Fire extinguishers to use in case of fire.

At our station and freight houses in cities where there is a water system we use hose and water plugs and Excelsior fire extinguishers. In other stations and freight houses we use water barrels and the Excelsior fire extinguishers.

In coaling stations we use fire plugs and hose and the Excelsior fire extinguishers.

We use Excelsior fire extinguishers. We have had no occasion to test any of them, so I am unable to say anything in regard to their efficiency.

We use on our bridges water barrels and buckets, and in some cases we have our watchman's shanty equipped with Excelsior fire extinguishers.

I know of no other protection for bridges that is better than water barrels and buckets, especially where there is a watchman, for he can take care of them and keep them full, and in places where there is no watchman it would depend on the track men to keep them full of water.

G. W. Rear, Gen. Bridge Inspector, Southern Pacific Railway:

Our system of fire protection in shop buildings consists of central pump under automatic pressure control, with a system of pipes to yard hydrants. Hose carts housed in detached houses and manned by an organized department, made up of employees and headed by foreman, master mechanics, or other principal officer in charge at this particular location. At some of the main points on the system the Gamewell electric fire alarm system is installed. At Sacramento alarm is given directly by whistle under automatic control of the system. At other points alarm is sounded on the gongs and repeated by hand by means of steam whistle. The fire department is drilled at least once a month and frequently once a week. In larger buildings interior standpipes, 1½-inch and 2-inch hose on racks or reels are provided. This hose is usually stretched out ready for use at night and Sundays, or at any time when the regular working force of men is absent.

In addition to the above water protection approved chemical extinguishers are located in accessible places and water barrels and buckets are provided. Sand barrels and scoops or shovels are in all round houses and in or near all oil rooms or houses. Steam smother pipes are connected to all large oil rooms at principal store points and to all oil tanks for storage of fuel oil.

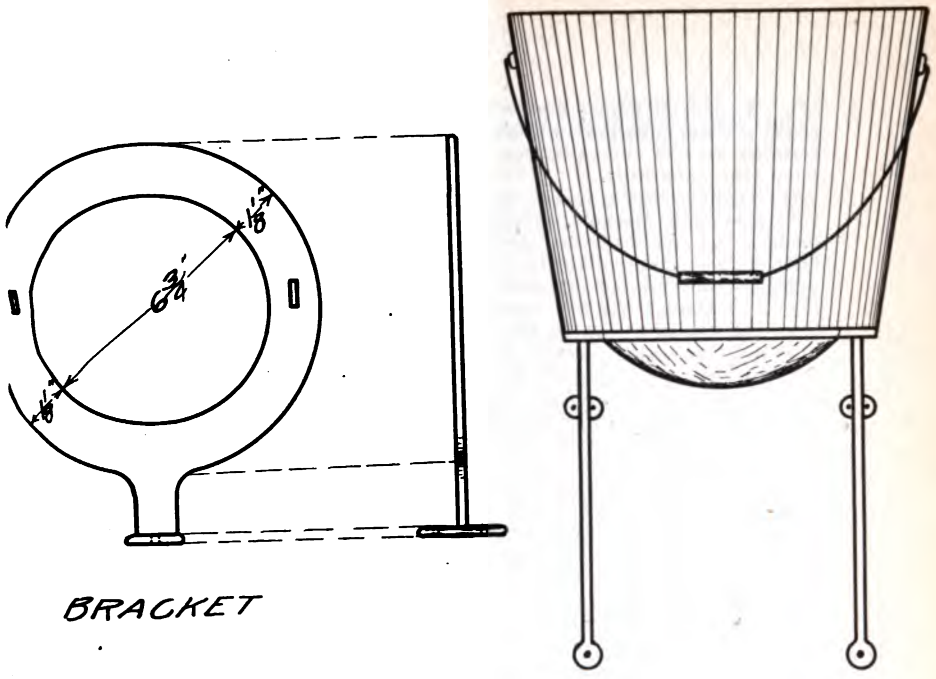
The standard equipment at outside ordinary combination depots consists of covered barrels of salted water, with a fibre round-bottomed bucket suspended in each barrel and light ladder with spiked shoe at the end. This ladder is hung on the outside of the building and sealed in place with car seals.

One or more chemical extinguishers are located according to conditions and where water under pressure is available hydrants and hose are provided. At terminals and sub-terminals, where pumps are installed at round houses, or otherwise, the mains are extended to protect all buildings and hose carts and hose are provided.

We have no elevators, but have docks and wharves, which are provided with regular Underwriters fire pumps of proper size and pipe system to hydrants with the necessary hose carts and hose to properly protect the structure. Steam pumps are always under steam (automatic control).

The system on other buildings varies according to conditions. In some cases we have automatic sprinklers; in others hose and hydrants, barrels and buckets, and chemical extinguishers in all.

We use for ordinary cases patrol 3-gallon chemical extinguish-



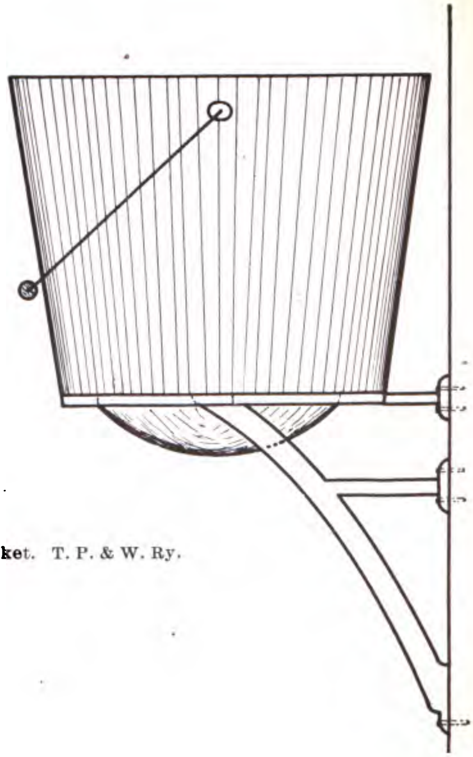


Fig. 62.— Bracket and Brace for Fire Bucket. T. P. & W. Ry.

ers. At special points and where we have a trained fire department, we use 6-gallon Babcock extinguishers, with extra charges forming part of the equipment. We have uniformly good results from this apparatus.

On wooden trestles and bridges we use water barrels with round-bottomed fibre buckets, similar to those used in buildings. On bridges and trestles under 150-ft. in length we use one water barrel buried in the embankment at each end of the structure. On longer structures we put barrels 150-ft. apart on platforms built for the purpose. We have had several cases where this system has been the means of saving the bridge or trestle and also have had a great many cases where the structure burned out before the fire was discovered, in which cases no such system of fire protection would have been of any use. We are using as many ballasted deck trestles as possible to reduce the fire risk.

The main trouble with the systems, as outlined above, for shop locations and other large centers is in the lack of properly organized and drilled night force to handle the apparatus. A fire house located on the premises and containing sleeping quarters for a number of men, equipped with fire apparatus and alarm system would give the best night service. Free room rent and good accommodations would make this attractive to men and no trouble would be experienced in maintaining a full force on duty. Six or eight men thoroughly trained could make use of the unorganized employees and get good results. The expense to the company, other than the first cost would be very small and the service would be more than worth the expenditure.

SOUTHERN PACIFIC COMPANY.

(PACIFIC SYSTEM.)

CIRCULAR No. 5.

(Superseding Manager's Circular No. 19, Oct. 15, 1902) September 8, 1905.

INSTRUCTIONS FOR THE PREVENTION OF FIRES.

To All Officers and Employees:

It will be the duty of superintendents to regularly inspect all buildings, bridges and other structures in the territory under their respective jurisdictions belonging to the company (and subject to injury by fire), with reference to measures to prevent such loss or damage. This inspection will extend to the methods used in handling, cleaning and storing fuel, oil, ashes, waste and all combustible materials and supplies; the handling, cleaning and care of all heating and lighting arrangements; the placing of cars with respect to the communication of fire to them, and the appliances provided for fire protection.

They will report result of their inspection to the General Superintendent, which report will contain a statement of the general condition of the property inspected, and recommendations for better protection wherever necessary. *Further inspection will be*

made by train and station inspector of each district, but such will in no way relieve superintendents of the duty above outlined.

SPECIAL INSTRUCTIONS.

1. The utmost vigilance must be exercised to prevent fires, especially in localities where great values are concentrated.

2. *Keep the premises clean.* Any accumulation of oily rags, waste or rubbish in and about buildings will not be tolerated. Particular attention must be given to train boxes in this respect.

3. As far as practicable, cars should be set so they will be accessible or readily moved in case of fire, and so distributed in yards and at shops as to prevent the possibility of a large loss.

4. Cars should not be allowed to stand near lumber mills, elevators or other hazardous exposures longer than is absolutely necessary.

5. All necessary measures must be taken to prevent the occupation of cars and unoccupied buildings by tramps, as a large proportion of fires originate from this source.

6. Examine carefully and frequently all heating and lighting apparatus in cars and buildings.

7. Do not pile lumber of any description within 100 feet of buildings.

8. Special provision must be made for the storage of explosives, and in no case shall such storage be permitted in depots or other buildings. So far as possible, this includes switch lights and oils.

9. Pools of oil must not be allowed to accumulate around oil supply tanks or between the rails at fuel oil stations. Provision must be made for proper drainage of oil from track at such points.

10. Be particular to have channels in all large coal piles. Old tubes should be placed upright in piles to give ventilation.

11. Avoid, as far as practicable, the use of lights around derailed cars containing oils or other combustibles; also about gas tanks of passenger cars.

12. Fusees and torpedoes must not be allowed to lie around loose in train boxes. They must be placed in the receptacles provided therefor.

13. Keep matches in metal or earthen boxes. Do not deposit ashes in wooden vessels.

14. Be extremely cautious in the use of candles and torches. Do not fill lamps by artificial light, and never use kerosene to start fires.

15. Wooden floors under and about front of stoves, and any adjacent woodwork, should be protected by a metal sheet. Watch this in station buildings, pump and boiler houses.

16. Wherever it is absolutely necessary to have stovepipe pass

through floors, sides or roof, have it properly guarded by tin and not within six inches of woodwork. Smokestacks must extend the proper distance above the roof.

17. Examine chimneys carefully and make provision for cleaning when necessary. Watch for defective flues.

18. Keep steam pipes free from woodwork, and do not permit clothing or any inflammable material to come in contact with them. Keep material away from all depot wiring where same is exposed.

19. In buildings and at bridges where barrels are provided, see that they are always filled with salted water.

20. Inspect all timber bridges carefully; keep grass cut and do not allow accumulation of old ties near them, nor shavings, sawdust or other inflammable materials on or under the floor, between stringers and packing blocks, and intersections of bridge members. Low bridges over dry runs are particularly liable to destruction from fires. The danger at such points may usually be obviated by spreading cinders over the ground, to prevent the growth of grass.

21. Fire extinguishers, hose, and other apparatus should be kept in good condition, in readiness for use at all times. Inspect them frequently.

22. Employees will communicate with the division officers when any suggestion occurs to them which will tend to lessen the fire risk in their vicinity.

I. H. Patton, Mechanical Engineer, Boston & Maine Railroad:

The appliances installed are as follows:

1. A Thermostat system.
2. A dry pipe sprinkler system.
3. A hose and hydrant system.
4. A watchman's clock system.
5. An electric supervision system.

THE THERMOSTAT SYSTEM is an automatic fire alarm.

The thermostat is a device which breaks an electric wire circuit, either by a fusible connection or by the expansion of springs through the heat from fire.

They are installed on ceilings and connected by electric circuits to the office of the Boston Automatic Fire Alarm Co. When a fire occurs an alarm is automatically sent to the central office, which is repeated as a fire alarm, calling a certain number of pieces of apparatus of the Boston fire department. The alarm is also given in our own office.

The thermostat connections melt at a temperature of 155 degrees, the sprinklers at 160. This difference is to insure the thermostats giving an alarm before the sprinklers cool them.

THE DRY PIPE SPRINKLER SYSTEM is one where the water is kept out of the supply pipe by air pressure to prevent freezing, the sprinkler head being a device screwed into top of supply pipe to throw water to ceiling. The orifice of head is closed by a plug held in place by a soft solder strut, which melts from heat of fire, opening head and allowing air pressure to escape, tripping dry valve, allowing water to come into system, which will forcibly flow out of all heads that are unsoldered, confining water flow to region of fire.

The Hose and Hydrant System consists of a 16-inch header, run the length of the property, connected to the city mains by branch pipes, controlled by gate and check valve, the latter opening with the city pressure. From this, header pipes are run to the several buildings to supply sprinklers and hose connections controlled by post gate valves at a sufficient distance from the building to allow of shutting off the water in case the buildings are burned and pipes are wrecked, so as not to lose pressure on the rest of the system. Three-way hose hydrants of the Underwriter's pattern are connected with this header. Reverse four-way hydrants are connected into the system with inside check valves, so that the fire department can attach leading hose of steamers to them, the suction coming from city main from city hydrants outside the check valves. This gives steamer pressure all over Boston & Maine system of piping.

The pipes are of ample size to insure a proper supply of water with the greatest probable demand, the mains being 12-inches and 16-inches diameter. One hundred thousand gallon iron tanks are provided of sufficient height to cover all buildings at Mystic and all except elevator at Hoosac, which is of iron and cement construction, with the exception of the bins, and was thought sufficiently fireproof not to need any protection. The tank at Mystic is 200-feet from ground to the bottom of tank, and at Hoosac 140-feet. These are connected to a header to give the primary supply, the city pressure, which is a secondary supply, being held out by check valves until the tank is emptied. A small pump fills the tank from a metered supply and in winter the circulation of water is maintained by pumping water through a heater in pump room to prevent freezing, as well as to keep water from stagnating.

The high tanks were installed as being more reliable than steam and electric pumps with pneumatic tanks and cost no more.

Watchmen cover their territory, reporting through signal boxes on their several routes to a watch clock in our central fire station.

The Electric Supervision is designed to keep all the above under continuous inspection, by having all the several devices electrically connected to indicators in a central station with continuous attendance to note any defect and to give fire alarm. Much of this apparatus was new to the manufacturers and had to be designed and adapted for the work, and progress has been very slow.

Fire Partitions have been built, with a curtain down from ceiling about 3-ft. deep on every other bay. This will pocket the air and heat the sprinkler head in case of fire quicker than if the air could sweep freely along. This will also prevent a quick spread of flames and smoke, allowing men to fight fire with more chance of confining it to one section. The partitions and curtain are made with two thicknesses of Sackett's Plaster Board, with studs on both sides of the partitions also covered. The fire doors in these partitions are of wood, tin covered, with automatic closing devices operated with fusible links.

All of this work has been installed under the rules, requirements and inspection of the Boston Board of Fire Underwriters. These rules specify the number and spacing of thermostats and sprinklers, size of supply pipes, make of hydrants, and in fact how all the work shall be installed, both as to workmanship and material. All devices have to be inspected and pass a rigid test before being accepted by them.

THE THERMOSTATS installed in the new sheds at Hoosac docks are of the fusible metal type. The other buildings on these docks, including first floor of elevator, are supplied with the Watkins thermostats, which are of the spring type. The Boston Automatic Fire Alarm Co., who installed this work, has a metallic circuit from thermostats to an automatic selector, which gives the number of building and floor to central station when alarm is given, where a record is made of time and location. The alarm is then given direct to three pieces of fire apparatus, protective department, and the fire boat. Wire circuits are duplex ground return. If a wire breaks they will still be able to get the indications and the circuits are tested every twenty minutes automatically. This refers to the old work. The new work in addition is a closed local system and is under continuous test.

Manual boxes are installed, one in every section of the house, which, upon the glass being broken and button pushed, will give the same alarm as if the thermostat was set off by heat, the location being noted by a red band marked "Fire Alarm" in white letters. All these circuits are looped into our central station, giving the indication there the same as to the Boston Automatic Alarm Co. office. The spacing of thermostats on all the new work is uniform with the sprinkler heads.

SPRINKLERS are installed in all the freight sheds and galleries by the R. I. Supply and Engineering Co. of Providence, R. I., and are on the dry pipe system, air being furnished by electric pump in each house, with relay of Westinghouse steam air pump. In house No. 42 the chlorine from bleaching powders affected the soft solder on heads, raising the melting point, so we have changed these for coated ones, to protect them from this trouble.

OUTSIDE OPEN SPRINKLERS are installed on the outside of several sheds. These are connected to a 6-inch main. They are operated by valves, the stem of which comes up through floor, properly marked, and are for use when the shed opposite is on fire. The 10-inch and 12-inch supply pipes to sprinklers are run on ceiling of first story of sheds and are protected from freezing as well as the dry valves. This has been done by encasing pipes and valves in double sheathing 2-inches apart and a steam pipe running next to the supply pipe the whole length of the shed. The valve houses are set as high above floor as possible to save the room on floor for freight purposes.

HOSE CONNECTIONS are provided in the several houses, with monitor nozzles in the second stories, two hose connections in lower stories at each outlet, and one on each nozzle. One of the two connections and one of the nozzles are connected with 50 or 75 feet of 2½-inch hose, with Underwriters play pipe attached.

The other connections are for the city fire department to attach their hose to when they come to a fire, without having to shut off the one being used by our men. The hose is piled in boxes on posts which are painted red, with white band in center, stenciled "Open Valve, Turn to Right." The supply pipe to these hose connections runs on ceiling of first story, and is shut off in cold weather by a valve at the end of the building to prevent freezing. This valve is operated by a hydraulic cylinder, using the city pressure to operate.

There are three 12-inch connections with the city pipe in street, with check valves in brick pits, half in street and half on our own land. Reverse four-way hydrants are located just inside our fence, with a gate cut through fence, held in place with cleats which will be pulled off by firemen when they wish to connect.

Two steamers can connect to each reverse hydrant. These 12-inch connections are provided with city shut-off gates and our indicator gates inside fence. The five three-way hose hydrants are located one in front of each shed. The two in front of houses No. 42 and No. 43 are enclosed with hose house, and a hundred feet of hose connected, a spare length being on shelf. These houses contain wrenches, spanners and axes. The other hydrants are provided with closets containing one length of hose, spanners and wrenches. Post gates are provided on pipes entering building, of which there are two to each building, one pipe to sprinklers and one to hose connections. These gates are marked with the number of building, and sprinkler or hose, as case may be. They have targets showing whether opened or closed, and are open normally, and will be only closed when the pipes are wrecked in the building. They are sealed open by the insurance inspector.

WATCHMEN are distributed as follows:

Two men in houses No. 40 and 41; one man in house No. 42; one man in house No. 43; one man in house No. 44; one man in galleries; one man in elevator; one janitor in office building acts as watchman at times; one yard watchman; three gate men.

THE CENTRAL FIRE STATION is located in the brick office building, occupying hall space on second floor, enclosed by an iron frame and wire glass partition. In this are located indicators for thermostats, giving location of each section, of all freight sheds and galleries on one indicator and all other buildings by floor and section on another. An indicator for water flow in the sprinkler system gives number of dry valves that trip. One shows high and low pressure of air; an indicator for all gate valves shows whether they are opened or closed; another shows low temperature in exposed water pipe, valve houses and tank; another high and low water in tank. The watchman's clock is located here, and watchmen ring in from their boxes, and the record is made in the customary way on card in clock. The wires that go to the clock are run through an indicator on operator's table, which shows white a spot as watchman rings his successive boxes, making a continuous white line for each completed round, the indicator being then set back for next round. To make each round takes from thirty minutes to one hour. This gives a continuous supervision of watchmen through the buildings and the attendant in the central station rings up to the Boston Automatic Fire Station every fifteen minutes, insuring his wakefulness and alertness on the work. A telephone on exclusive wire to Boston Automatic Fire Alarm Co's. office is installed; also another telephone line is run to pier No. 42, as being a central location from which communication can be had to central station. An electric gong is located on each pier, operated from this office by push buttons to call watchman's attention to any trouble on his pier that needs attention, or for fire on the premises. If a watchman fails to ring up, the track watchman is notified either by gong bell or a red electric light outside the window, and he investigates. A city fire alarm box is located on operator's table. A storage battery in duplicate is located in the room to operate the several electric circuits, being charged by motor generator, the current being supplied by our own power. A framed white print of the property is hung on wall, showing location of all pipes, gates, valve houses by numbers, hydrants, hose outlets and other details. Cards are provided for daily reports, showing conditions for the preceding twenty-four hours. On it is kept recorded time of each watchman's route as he makes it on his rounds, and the record is compared with clock card to check both. The outside inspector also makes report on card, certifying to conditions of outside work, hydrants, hose, number of fire drills, etc. These cards are filed for our own information, a duplicate card being sent the Boston Fire Underwriters. Continuous attendance is provided by three operators in eight-hour tricks, changing tricks every week.

The installation at Mystic docks is similar to the above in general aspects and accomplishes the same purpose.

SYNOPSIS OF LETTERS REFERRED TO IN FIRST PARAGRAPH.

The following information taken from forty replies on the subject:

Shops for Mechanical Department.

Six have automatic alarm system.
Eleven have code of whistle signals.
Sixteen have regular fire drills.
Two have special fire pumps under steam at all times.
Twenty-seven have shops thoroughly protected with fire plugs from city water works.
Eleven are protected only by water barrels and pails.

Passenger and Freight Depot.

Twenty have provided water barrels and pails.
Ten thoroughly protected by city water works.
Fifteen use various fire extinguishers.

Coaling Stations.

Three have special water tanks for fire protection.
Two have pumps under steam with hose attached.
Twelve depend on water barrels and pails.
Six are protected by city water works.
Seven use chemical fire extinguishers.
One reports fusible electric bell signal in connection with dock.

Elevators and Docks.

Seven report steam pumps under steam at all times.
Eight depend on water barrels.
Seven thoroughly protected by city water works.
Balance have no elevators or docks.

Promiscuous Buildings of Less Importance.

Four report having special high tanks for water.
Two report steam jets in good buildings.
Fourteen report using water barrels and pails.
Eleven report depending on various fire extinguishers.
Balance make no report.

Fire Extinguishers Used.

Seventeen different kinds of hand fire extinguishers reported, some favorably and some unfavorably, but the majority have never had occasion to use them enough to make a thorough test.

Bridges.

Six report using sheet iron to cover stringers and caps to protect timber from fire.
Two recommend whitewashing to prevent fire, stating that experience has convinced them that it is a good preventative.
One uses and recommends fireproof paint.
Thirty report using water barrels and pails.
Some claim to have used them with profit; others have never used them enough to pay for the expense. One man reports having all wooden bridges protected by water barrels for the last ten years, but never had occasion to use them at any time.
All recommend keeping bridges clear of inflammable trash, especially dead grass; also trimming off rotten sap.

Committee { J. N. Penwell, *Chairman,*
D. C. Zook,
A. B. Hubbard,

DISCUSSION.

Mr. Killam.—At all our small bridges we have an oil cask sunk in the ground with a lid on it and the section men are required to keep these barrels filled. On long bridges these casks are placed 75 or 100 feet apart. In one particular instance this summer, where we have a 400-foot bridge, the forest fires burned down fifty-two houses at one end of the bridge and eleven houses at the other, yet we saved the bridge by using the water kept in these barrels. At the large stations, where there are waterworks, we have hose attachments in different parts of the buildings and also chemical fire extinguishers. At the medium-sized stations they have these casks set in the ground and at larger places, like headquarters, they have a fire brigade made up of railroad men, and they drill once a week.

Mr. A. S. Markley.—I would like to ask Mr. Killam how he keeps the water in these casks from freezing.

Mr. Killam.—When the dry weather is over and the snow comes there is no further necessity for this water and the barrels are emptied and refilled in the spring.

President.—Water may also be prevented from freezing by putting quite a lot of salt in it.

Mr. Sheldon.—Our road has recently adopted a solution of calcium chloride. We tested it last winter when it was eight degrees below zero, and there was a small amount of soft ice on top, but the water below was clear and free from ice. Since then this has been adopted as a standard. By using salt the water gets so in cold weather that you cannot handle it with a pail. Even a very salt water will harden up in severe cold weather. The amount of calcium chloride that we use is about 85 pounds to 50 gallons of water, which will keep the water from freezing unless the temperature goes under 18 degrees below zero. You can make your solution weaker or stronger according to the temperatures you expect.

Mr. Perry, P. & R.—On most of our bridges the only protection we have against fire is barrels placed in the ground at each end of the bridge or trestle, and at intermediate points if the bridge is very long. We use salt in the water to keep it from freezing. I do not know of a case where it was frozen up so that we could not use it. Some years ago, on the Catawissa Branch, we had seven trestles; the average height was from 75 to 130 feet. The length varied from 500 to 1,150 feet. These trestles we kept whitewashed and I have no recollection of their having caught fire to any extent. We gave them a very heavy coat of whitewash and renewed it every two or three years. I believe whitewash is a good protection from fire. You will find it almost impossible to burn whitewashed lumber. Of course we also kept barrels of water on these trestles, as an additional protection. We did not keep any account of what it cost to whitewash these structures. Practically the only cost was for the material, as the work generally was done by the bridge watchman.

Mr. Staten.—I presume the subject includes buildings. We have all our buildings insured and about every two years the insurance agent goes over the road and makes recommendations, and he sees that we keep a sufficient number of water barrels around our wooden structures.

Mr. Aldrich.—In the matter of fire protection, water barrels placed on bridges do not always prevent fires, as we recently had a case where we assume that the fire started about 6.30 p. m. and burned until somewhere around 5.20 a. m., burning out about 72 feet in length of a double track trestle.

In a case of this kind the water barrels would be of but little use, with or without pails, as there was no one there to put out the fire until the track walker came along. It is my opinion that one of the best fire preventatives, and which is also a wood preservative, is whitewash, and I think that the whitewash can be put on to pile trestles very economically with a sprayer, and it would go a long way toward prevention of fire. I am not averse to the use of water barrels and fire pails, but it is a very hard matter in our part of the country to keep pails in the barrels, even though we use round bottom pails and punch holes in them.

Mr. Killam.—We make our pails with a round bottom, so that they will not stand up, and have no trouble with their being taken away.

President.—In addition to punching holes in the bottom, if you will smear them with tar or pitch it will be found that people will not take them very far.

Mr. Riney.—Our men have had much trouble in keeping pails at water barrels on bridges. Lately we have been constructing a substitute for pails by making a box of one-inch boards, 10-inches x 10-inches x 10-inches on inside. Handles are provided for these boxes of No. 8 wire, similar to those on an ordinary pail. These square pails, as they may be called, are submerged in our water barrels by being loaded with a stone of sufficient weight. They cost about one third as much as the galvanized iron pail generally used, and will, undoubtedly, answer purposes equally as well.

Mr. Killam.—Of course one thing that aids in the prevention of fires is to have tight fire boxes on engines and see that firemen do not shake fire box near a bridge. Another precaution is to have good sound decks on bridges and paint them well, keeping free from rotten places where the fire can catch.

Mr. Penwell.—I would ask Mr. Perry what parts of bridges he would whitewash.

Mr. Perry.—We whitewash our trestles from top to bottom. I believe, however, they could be sprayed cheaper than it would cost to go over them with a brush.

Mr. Sheldon.—I would like to ask Mr. Perry what effect the whitewash had on his bridges. Did it preserve the timber?

Mr. Perry.—Yes, the whitewash was a preservative as well as a fire protection.

Mr. Sheldon.—Why have we not put whitewash on all our bridges, not only to prevent fires but to preserve them?

President.—Possibly it is because it has been considered an additional expense and never thought necessary.

Mr. Clark.—I think that whitewashing trestles would be a very expensive matter and as our fires generally originate on the chords, why would it not be cheaper to cover the chords with galvanized iron than to whitewash the whole bridge?

Mr. Steffens.—The method of covering with galvanized iron is an old and tried remedy. I have seen it specified within the last year on some of the western trunk lines.

Mr. Beahan.—The L. S. & M. S. is having an inspection made of all their buildings, with a view to protection against fire, among other things, and as all departments are represented on that committee, perhaps their recommendations might be of some practical value to our committee.

Mr. Penwell.—With the additional information as given in this discussion, the committee on this subject will endeavor to get its report completed for publishing in our next Proceedings.

President.—If there are no further remarks on the subject of fire protection, we will pass to the next subject.

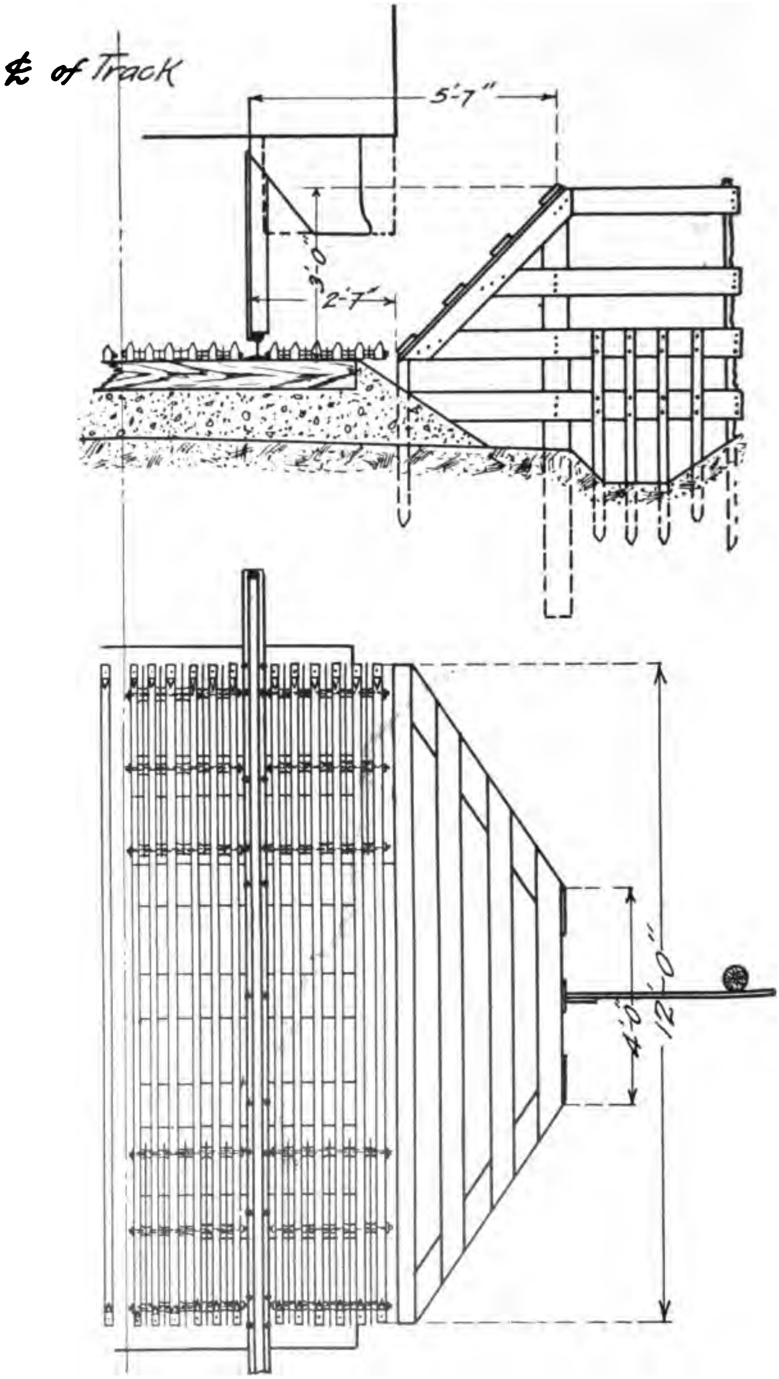


FIG. 63.— Cattle Guard. C. & N. W. Ry.

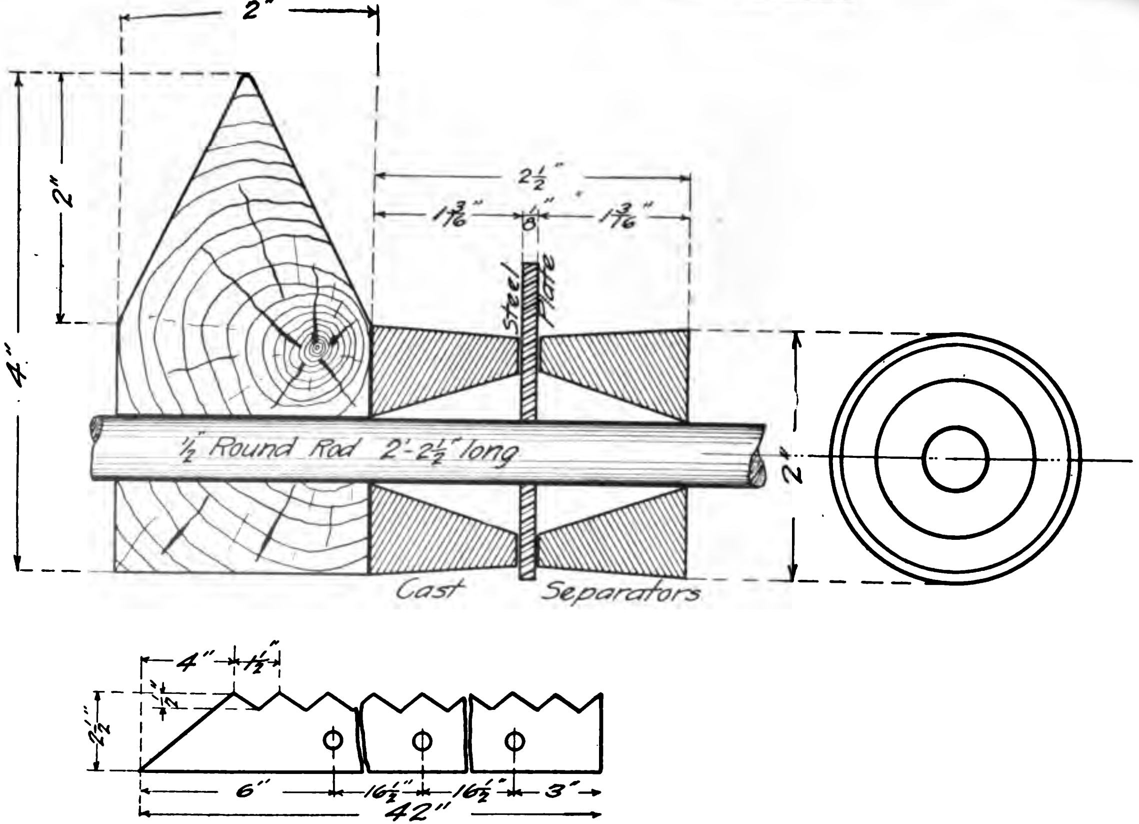


Fig. 64.—Cattle Guard. C. & N. W. Ry.

FENCES, ROAD CROSSINGS AND CATTLE GUARDS.

(Standing Subject No. 3.)

(No report.)

DISCUSSION.

Mr. Steffens.—In the middle South we have trouble with small black hogs running through our cattle guards. The wooden cattle guard is perhaps the cheapest on the whole and will keep out cattle, but not these small black hogs. We have therefore tried the experiment of putting at either end of the 12-foot slats, which are planed to an edge to keep the cattle out, a bar of iron 24 to 30 inches long and with a tooth effect. Cattle guards are something that the railroads are interested in on account of damage suits that are constantly arising, due to stock being killed.

Mr. Spencer.—We are experimenting now in our country with a patented cattle guard, which is a positive guard. No cattle or horses can get over it and it is at one of the worst places on our road, where hardly a day passes without forty or fifty cattle getting on our road. It is rather expensive, as I think it will cost not less than $15 to $16 per guard, but it does the work.

President.—If possible, will you kindly send the Secretary a blue print of that guard.

Mr. Spencer.—Yes, I will do so.

President.—Is there any further discussion? If not, we will pass to the next subject.

CONSTRUCTION OF COFFERDAMS.

(Standing Subject No. 4.)

REPORT OF COMMITTEE.

To the Association of Railway Superintendents of Bridges and Buildings:

Your committee appointed to report on the above subject issued a circular of inquiry to twenty-seven of its members—the number of replies received is indicated in the appendix to this report. It was thought best to reprint them as written, that all the information they contained would be made a part of this report. We were somewhat disappointed in the number of replies received. We had hopes of more assistance from the members, that we might be able to spread on the records not only a report from your committee, but a report from the members of this Association.

We all, undoubtedly, have had more or less experience in sinking foundations where there is no water. If it is necessary to go to such a depth that there is more or less danger of the embankment caving in, one should set plank around the outer wall, and put in suitable wale timbers and braces, driving the sheathing down as the excavation proceeds. In clay soil the sheathing need not be tight, as it is necessary in sand. Such a construction as this is often called a cofferdam.

The proper meaning of a cofferdam is a water-tight enclosure. Its construction depends on the depth it is to be carried, the depth of the water and soil, and character of the soil. The depth that a cofferdam is to be carried down is, in most cases, defined. Where it is necessary to put in deep foundations, especially where there are ten or twelve feet of water, considerable good judgment is required. Unless you drive the staves far in advance of the excavations, the water is very apt to break under them during the process of driving. If the soil is clay, you will experience very little trouble. If sand and gravel, the water is very apt to force its way under the staves.

The size of a cofferdam clearance around the pier or abutment seems to vary considerably. It should be made as small as possible—the smaller the dam the less water it will hold, and that means less tax on your pumps. Six feet is needed in one end for a centrifugal pump. A two-foot clearance on the inside of the wale timbers is plenty.

These dimensions and the depth determined—if cofferdam is to be constructed in water,—next in order is to drive four piles, if nothing else to anchor to is provided, just inside of the frame at each corner. The wale timber frames are then put in. If staves are of the Wakefield pattern, three-ply 3 by 12, frames from four to five feet apart are made of 12 by 12. The struts should be of the same size and not to exceed six feet apart. It is very necessary to have three of the frames set up; if in water, the frames should be settled so the lower one rests on the river bottom. Care must be taken to keep the frame level.

The driving of the staves is the next thing in order. As set up, they should all be driven some two or three feet, just enough to hold them until all are set. This done, one should follow around and drive them down two or three feet farther. The advantage gained by setting up all of the staves as indicated is to keep them from spreading. If staves are very long, it may be necessary to bolt one to the upper frame occasionally when they are set up and driven the first time. At the second driving bolts can be removed. It is absolutely necessary to keep the staves driven as far ahead of the excavation as possible, in order to keep the pressure from crowding the staves in at the bottom. In this connection, too, it must be understood that when the excavation has proceeded far enough below the lower wale timber frames, another frame must be put in. It may be found necessary, on account of very hard driving, to put this frame in before the regulation distance has been reached, in order to safely stay the staves from crowding in. In such cases, jacks can be set between the frame just put in and the one above it, to crowd the lower one down, as fast as the excavations permit, until the regulation distance has been reached. If these precautions are not taken, the staves are sure to crowd in, thereby reducing the free space that has been allowed between the curb and the masonry.

The method of driving staves has not been touched upon as yet. For such staves as have been referred to in this subject, three-ply 3 by 12,—either a steam hammer or a common one such as is mostly used, weighing 2,500 to 2,800 pounds on a five to eight foot stroke—such as are used in a common land or unmounted driver, can be made to serve the purpose. The one found most practical has a short set of leads, say not over 16 to 20 feet long, swung on the end of the derrick boom with a hammer weighing not to exceed 1,400 pounds. (See half-tone picture, Fig. 65, showing the leads swung and ready for operation.) The advantage of a driver of this kind over the other two is, it is more simple and is easier to handle when driving. Hammer can be kept directly over the head of the stave that is being driven and, when through driving, laid down out of the way. When needed it is very quickly picked up and put in operation. One man is all that is needed to hold the lower end of the leads in place.

Thus far this report refers to cofferdams of rather heavy construction. When knowledge is at hand of this class, it is a very easy matter to master the smaller ones. In the appendix to this report some valuable information is given in regard to the smaller cofferdam construction.

Before concluding this report we wish to make reference to some cofferdam work that has been carried on for the Toledo, Peoria & Western Railway Company at Peoria, Illinois, in renewing three piers under their Illinois River bridge. This work was commenced in October, 1905, and completed December, 1907. During this time there was about eleven months' delay, owing to high

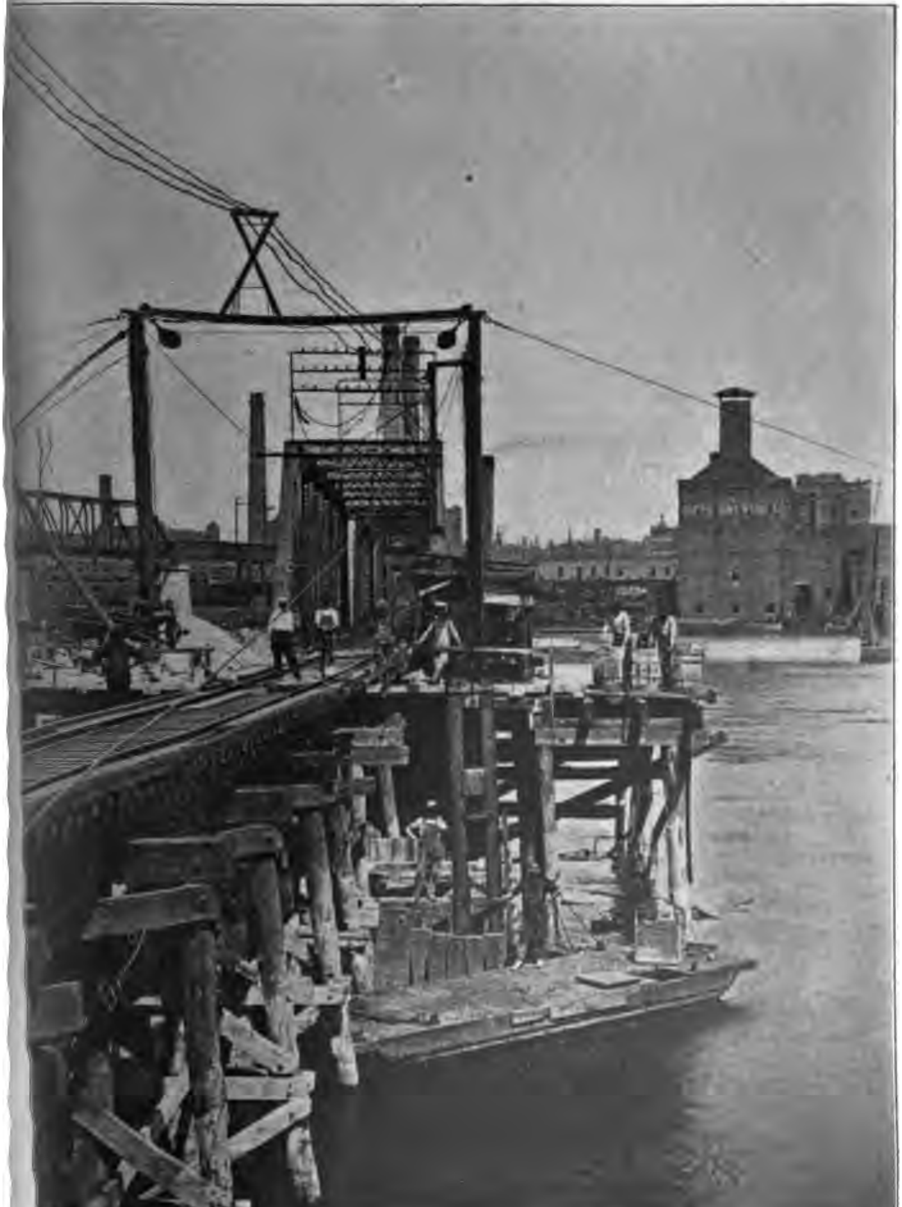
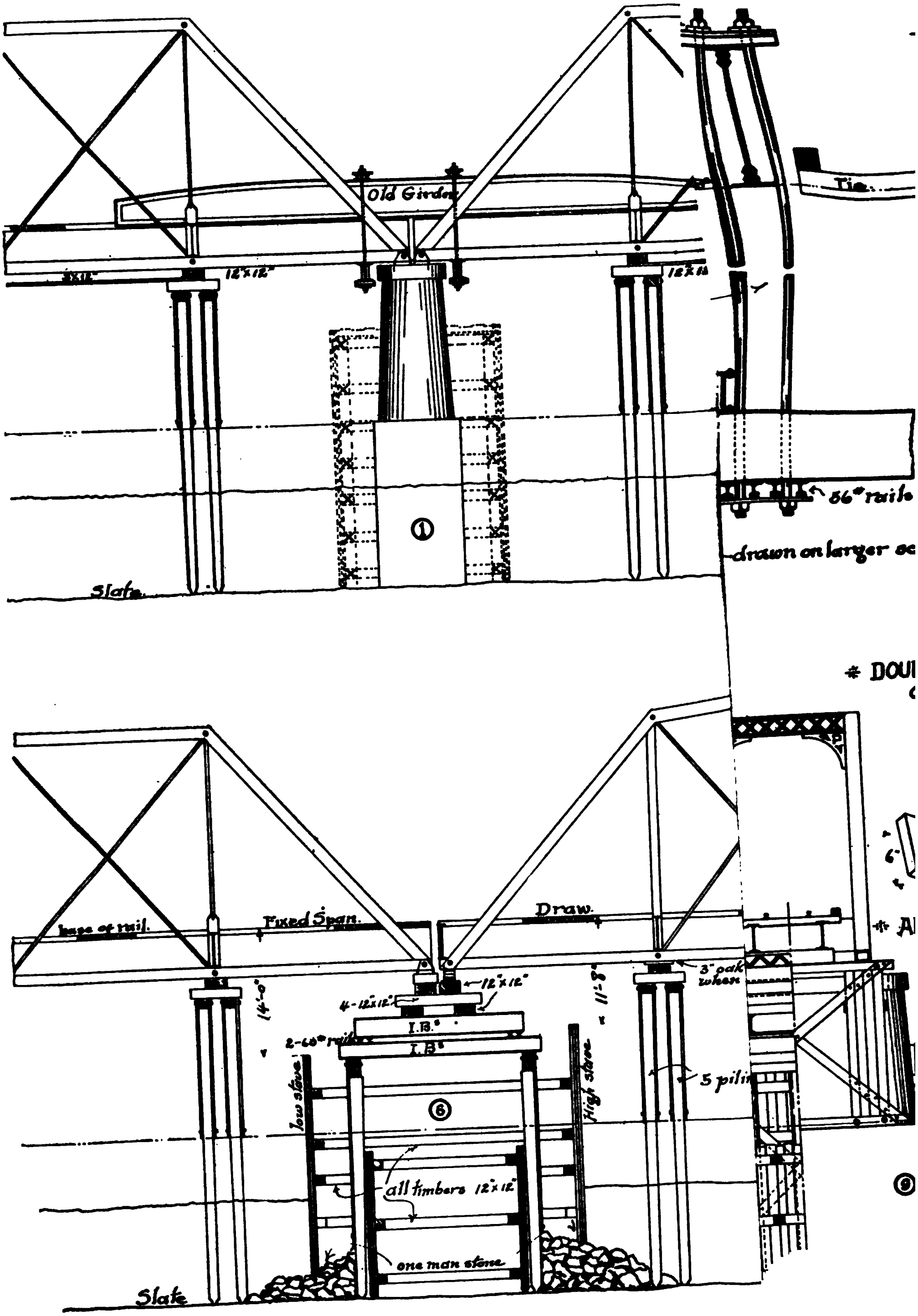


FIG. 65.—**Showing Leads** swinging ready for operation. Toledo, Peoria & Western Ry.

water and severely cold weather. In order to make this work plain to you, cuts have been made of it. In producing them there is some work shown that is not in line with the subject of this report, as the plans were made not only to show the cofferdam work but the manner of carrying the bridge and traffic during the renewal of these three piers. It was thought best to produce the entire plan in hopes that it may be of interest to our members. The cuts show two sets of the frames of the cofferdams, excepting the bracing that was bolted on as each frame was added in order to keep the struts from buckling. Near the bottom of the two last dams the frames were put in three feet apart and some of the struts reinforced. It was found necessary to do this on account of the increased pressure caused by extreme high water (being at times 15 feet deep, or a total of 26 feet from surface of water to the bottom of the dams). You will note that there were no rods used in connection with these frames. The cut shows, too, the kind of staves used, being 28 feet long, of three-ply 3 by 12 pine surfaced on one side, and of the Wakefield design. Many of these staves have been used four times, and excepting where the points struck the rip rap stone they are in good condition. The manner of driving these staves was by swinging the leads on the end of the derrick boom (see Fig. 65), using a 1,300-pound hammer. A water jet of 150 pounds pressure with a 1¼ inch nozzle is provided. The nozzle was kept as near as possible to the point of the staves. We did the jetting all from one side—the inside of the dams. We were obliged to do this on account of the stone that lay too near the outside of the dams to do otherwise. This practice should not be followed. As the jet loosened the dirt, naturally the point of the stave would follow the jet and loose earth, and when the excavations were made it was found that the bottom of the dam was somewhat smaller than the top, in some cases as much as 12 inches. One would naturally think, inasmuch as the staves would draw in 12 inches at the bottom, they would show an inclination to lean out at the top. This was not the case. The corner stave in every case went down straight; the next one to it would twist slightly inward; this would give the next one a start, and as the center was reached they would, in most cases, draw in from 8 to 12 inches. With but one exception we jetted and drove the staves from 10 to 12 feet in advance of the excavations. In fact, we aimed to drive them clear down before making any excavations whatever.

You will notice in the cuts (see Nos. 6, 7, and 8), limestone rip rap; this was of all shapes that you can imagine. In sizes stone ran from 75 to 150 pounds. In some places it lay five feet deep. You will notice two cofferdams. The outer one was put in first with a view of getting outside of as much of the stone as possible. The dam was put in very carefully, and when completed two centrifugal pumps, one 10-inch, one 6-inch and one 5-inch steam pumps were started, and the water could be lowered only 10 inches. The stone that most all of the lower ends of the staves rested on formed an opening for the water. The next move was to put in 25 carloads of clay, grading it over the entire enclosure as best we could. Then the inner dam was put in, making it just as small as was possible to work with. The staves in this were made of 2 by 12 by 16 feet S. 1. S. of the Wakefield

Old Girder
3x12"
12"x12"
12"x12"
Tie
56# rails
①
drawn on larger sc
Slate
# DOU
base of rail
Fixed Span
Draw
14'-0"
11'-8"
3" oak when
12"x12"
4-12"x12"
I.B.s
2-60# rails
I.B.s
⑥
low stone
High stone
5 pili
all timbers 12"x12"
one man stone
Slate
6"
# A
⑨

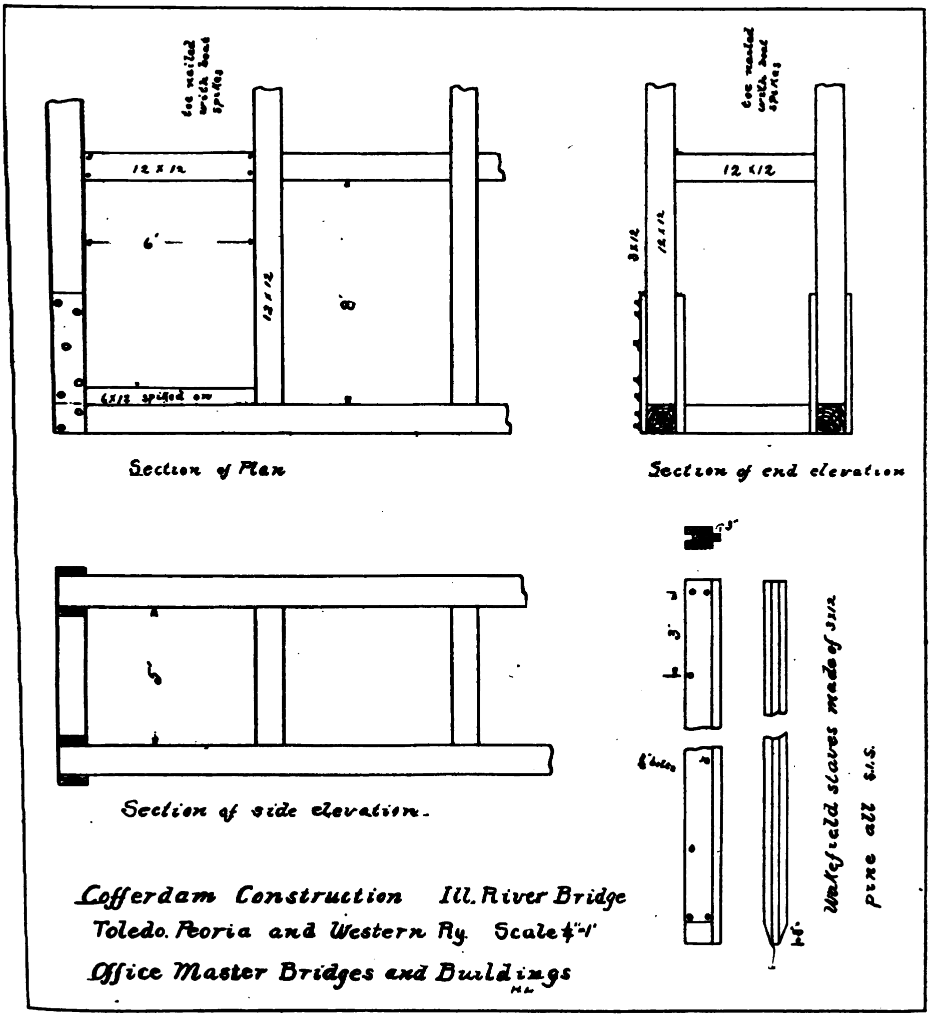

toe nailed with boat spikes
12 x 12
6'
12 x 12
8'
6x12 spiked on
Section of Plan
toe nailed with boat spikes
12 x 12
3x12
12 x 12
Section of end elevation
6'
Section of side elevation.
3"
3'
4" bolts
1½"
Wakefield staves made of 3x12
pine all S.1.S.
Cofferdam Construction Ill. River Bridge
Toledo. Peoria and Western Ry. Scale ¼"-1'
Office Master Bridges and Buildings

FIG. 67.—Cofferdam, Illinois River Bridge. Toledo, Peoria & Western Ry.

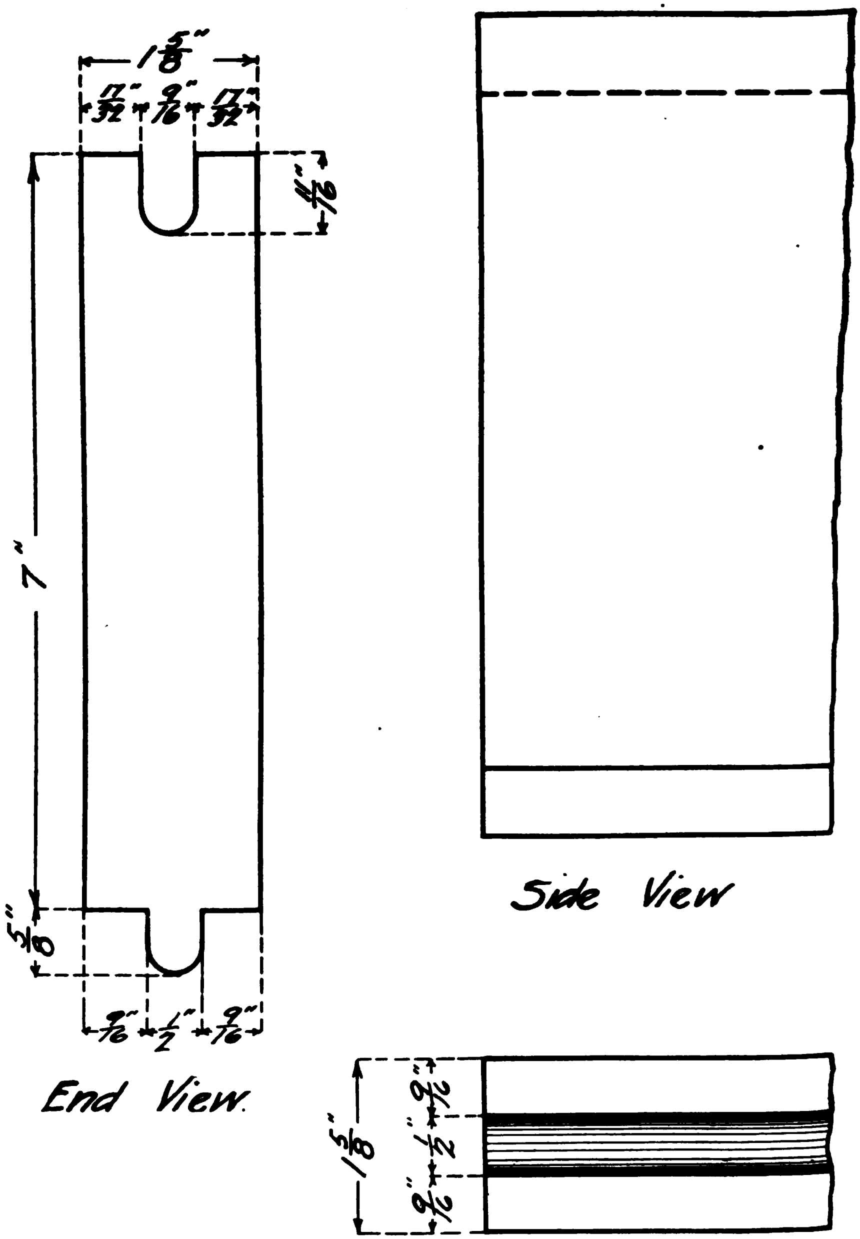


FIG. 68.—Sheet Piling. Chicago, Milwaukee & St. Paul Ry.

design. The staves were all driven as far as possible on account of the stone. The pumps were again started and at the same time the jet was put to work jetting the clay that lay between the two dams down in the voids of the stone. This method proved partially successful so far as keeping out the water was concerned. When we commenced taking out the stone that lay on the inside of the inner dam and under the staves of the same, trouble commenced. Every stone that was pulled from under the staves brought with it a great leak until we would drive the stave down as far as it could be for the next stone. Driving the staves onto the stone, that lay in every shape and angle, was proving very disastrous to their points. As a last and final method we employed a diver. As fast as he would clear the stone from under the staves they were driven to final depth.

If any reliable record had been at hand as to the character of the foundation on which the old pier set, we could and would have proceeded very differently. We knew it did not extend—as the new ones do—to solid stone, but we did not know whether it set on piling or simply the river bed. It was found to rest on bed of river on a timber grillage. Had we dredged the rip rap stone that lay around this pier out of the way for the cofferdam, we undoubtedly would have turned the old pier over, as in some places this stone lay below the bottom of the old pier.

Committee
J. H. MARKLEY, *Chairman.*
J. P. SNOW,
F. O. DRAPER,
W. J. GEORGE,

APPENDIX

Moses Burpee, Chief Engineer Bangor & Aroostook Railroad:

Replying to circular of committee on Standing Subject No. 4, Construction of Cofferdams:

1. Depends on character of bottom. If of mud to be excavated to considerable depth, drive piles for support to waling pieces, then sheet piling. If rock, with only a little overlying mud or gravel, this may possibly be cleaned off by scraping and a caisson sunk on the site and filled with concrete.
2. Size of wale timbers depends on their number, the depth of water and strength of current, and perhaps on whether or not the cofferdam is likely to be struck by boats or driftwood. So many circumstances may influence the case as to make theoretical deductions from hydrastatic pressure and strength of timber incomplete, though they should, of course, be considered, and additional strength allowed if apparently necessary.
3. Same as second.
4. Experience with sheeting is very small. Prefer triple thickness similar to Wakefield pattern where depth is sufficient to require it, but in shallow work would use single sheeting supported by waling. Tongue and groove material is probably the more economical and really the only thing to be considered where cofferdam is at all required.
5. A heavy wooden maul is the most economical where it will answer the purpose. When it will not, a small pile driver, with a hard wood block for hammer, does good work. It is light and can usually be improvised in out-of-the-way places, where possibly the best appliances cannot be had, or at least do not happen to be at hand. The hammer may be raised by two men pulling on a line over a sheave at top of leads (which will probably be not more than 10 ft. high), dropping the hammer probably not more than 3 or 4 ft. each blow. Where the amount of sheet piling is large, a steam hammer, suspended from a derrick would doubtless pay for heavy work, or a steam drill rigged with cast iron block in place of the drill for lighter work.

Think the above statement with cutting tools would be successful in cutting through obstructions.

So many cases of cofferdamming occur in places where heavy machinery cannot be provided, owing to transportation limitations, that frequently the most primitive appliances must be used rather than those which would be much more effective and economical in more favorable conditions; or the extent of the work under certain conditions may or may not be so great as to warrant the expense of installing the method approved for another case under different conditions.

The study is therefore one of absorbing interest, and I hope the labor of the committee may be productive in recording a large amount of information and personal experience.

C. F. Loweth, Engineer and Superintendent B. & B. and T. Lovel D. Hadwen, Asst. Engineer, Chicago, Milwaukee & St. Paul Railway:

Replying to your committee circular on standing subject No. 4, the character of the cofferdams in use varies so widely according to the individual conditions to be met that only a general answer can be made. For shallow foundations such as are needed in arch and culvert construction we use sheet piling made of 2" x 8" dressed and matched timber. This material is sized as indicated on blue print (Dr. No. A.–6131) and has a longer tongue than ordinary matched lumber, securing better alignment and tighter joints. This material is carried in stock in lengths of 12, 14 and 16 feet, and from fifteen to twenty thousand pieces are used annually. The commonest length used is 16′, which will make three 5′ 4" sheet piling, a length ample for most shallow culvert foundations. However, sheeting of this character, as deep as 10′ or 12′ is frequently used, especially for pier and abutment foundations. Generally this sheet piling is driven by means of a sheet pile pounder or ram, weighing about 70 pounds and operated by four men, in preference to using a mechanical driver.

For waling and braces in such cofferdams, S. H. car sills are largely used when obtainable. Formerly chord timber from old Howe Trusses was used. In deeper foundations a triple lap sheet piling is used, built up of 3 3x12 spliced out to give the length of sheet piling required. This sheet piling is made with a three-inch tongue and is fastened by 2 rows 7" wire spikes spaced 1′ 6" in addition to being bolted with two bolts either side of splices and at the ends. This summer sheet piling of this character, 34′ long, was used in a pier in the Chicago River and a very tight dam obtained. Special corners built up of six pieces are used. The sheeting is cut back 6" from the face of the tongue and the sides are chamfered to give a width on the point of about 6 inches. This sheet piling is driven with an ordinary track driver, a follower with a wrought iron plate serving to protect the head. In some cases a false pile is driven down and pulled back 12" from the last pile at the top and clamped in this position with a ship builder's clamp, and made to serve as a guide for the next piece of sheeting. Where sand occurs and the work is extensive enough, a water jet is used to put the pile down.

For the larger cofferdams 12" x 12" timbers are used for waling and for main struts, spaced according to pressure. We have not built many cofferdams with steel sheeting, but on one of the crossings of the Yellowstone River, steel sheeting made up of 15"–33-lb. channels and 4 x ¼ Z bars was used with satisfactory results.

J. N. Penwell, Supervisor B. & B., Lake Erie & Western Railroad:

1. Where the driving is hard or when there are a number of cofferdams to be constructed, I believe that metal is to be preferred as it can be saved without much loss and used many times. It would, however, be expensive to carry a stock of different lengths for any ordinary railroad.

2. The size of wale timbers depend on how far apart the struts

are to be placed and in no case should the timbers be less than 6 x 8 inches. The strongest ordinary corner is to butt the wale timber at the end against the wale timber at the side, having previously bolted a good long block to the side timber for the end timber to lay against. Wale timbers should be spaced from three to four feet according to depth of cofferdams. If more than two sets of wale timbers are to be used, they should be strutted proper distance apart and held in place by vertical rods along side of struts and then apply weight at top to hold in place until staves are started.

3. For greatest strength for the same amount of timber the struts should be square. The size and spacing of the struts must be governed by depth of cofferdams and character of the material to be excavated.

4. Single thickness is stronger than Wakefield pattern. On account of expense I prefer single thickness for shallow work, but for cofferdams exceeding 12 feet deep, I prefer the Wakefield pattern, as it is much easier kept in place. Where double line of sheeting is used the tongue and groove sheeting should come on the inner line of the cofferdam, unless there is much wash, but for much wash from waves or otherwise would prefer it on the outer line. The point on the stave should be blunt for one third the width of the piece and the balance cut off at an angle of about 45 degrees.

5. My experience in driving staves has been with wooden mauls; for heavy driving I would recommend the use of pile driver leads swung to place by a derrick and a hammer, not to exceed 1,200 pounds; would also recommend water jet whenever it can be used successfully.

My experience is, get your cofferdam large and strong enough in the start. As to rip-rap, boulders and tree trunks, the best method is to remove them by clam shell dippers, which can be rigged to a common derrick or in case of tree trunk by pulling out with lines attached to driver. If stone and timber is buried, do the best you can under the circumstances. It sometimes means new and larger cofferdam.

F. E. King, Asst. Engineer Chicago, Milwaukee & St. Paul Railway:

My reply to the attached circular, which has been referred to me by Mr. C. F. Loweth, has been considerably delayed on account of rush of business. The following is a statement of my experience on the points raised in these questions:

As to question one:

My experience has been entirely with wooden sheeting. The methods employed varied more or less with each particular job. What might be best at one particular point might not be best in another. Ordinarily, however, we construct one or more frames to define the size and shape of the cofferdam. With the frame in position the driving is usually started at one corner and continued in one or both directions around the frame. If the cofferdam is to be of considerable depth, the driving is usually done with steam power. Otherwise the sheeting is driven by hand by means of iron rams. These rams have a bell-shaped head with a handle about 4½ feet long, striking face about six inches in diameter and weighing 50 to 85 pounds. These rams are operated with two to four men. The driving is continued around the dam until the sheeting have all been driven as far as conditions will permit. If only one frame has been used to start with, other frames are added as the excavation proceeds.

As to the size of wale timbers called for in question two:

Where the cofferdam is only four or five feet deep, I have used wale timbers as light as 3" x 6" turned flatwise against the sheeting. Where the cofferdam has been 6 to 10 or 12 feet deep, the most satisfactory timbers I have ever used is second-hand car sills or timbers of equal dimensions. These are usually 4½" to 5" thick by 9" to 10" wide. These timbers were turned flatwise against the sheeting. For depths of greater than 10 to 12 feet, 12" x 12" timbers have proven most satisfactory. The spacing of these wales varies considerably with conditions. If a single thickness of two-inch sheeting is being used, the distance ought not to be more than three to three and one-half feet. If Wakefield sheet piling composed of three-inch plank are being used, however, I have found the distance of six feet to be quite satisfactory. If the Wakefield sheet piling are constructed of two-inch plank, I have spaced my frames about four to five feet apart.

If the cofferdam is of sufficient depth to warrant driving round piles for guides I have usually held the wales in position by means of a few spikes through them into the piles. If round piles are not used I have sometimes held the frames in position by means of guy lines or braces to some available structure.

The framing of the wale timbers has usually been done by halving them at the corners and then bolting them or spiking them through each piece. Where several of these frames are used one above the other I have separated them by means of struts of the required length and tied the various frames to each other by means of vertical rods through two successive frames.

In answer to question three, about size of shores, etc.:

Where the cofferdams do not exceed 10 or 12 feet in depth I have found second hand 6 x 8 inch bridge ties or second hand car sills make very satisfactory struts. In some cases I have used pile heads flattened on two sides. For depths exceeding 10 or 12 feet I have generally used 10 x 10 inch or 12 x 12 inch timbers. The framing of these struts usually consists of square butt joints with the wale timbers. If struts are also used at right angles to these they are usually cut and fitted between so as to occupy as little room as possible and also prevent the first mentioned struts from buckling.

Replying to question four:

I prefer to use single sheet piling for shallow pits and Wakefield for deep pits. The single sheet piling used consists of 2 x 8 inch lumber dressed and matched. This gives a thickness after dressing of about 1⅝ inches. I have used this sheet piling successfully for cofferdams of 10 to 12 feet deep. Where depth like that was encountered and sometimes for very much less depths it has been necessary to place an embankment of earth around the outside.

For Wakefield sheet piling 2 x 10 inch lumber and 3 x 10 inch were used. My experience with the 2 x 10 inch lumber has not been satisfactory and I do not recommend its use in any case. The Wakefield sheet piling composed of 3 x 10 inch lumber in single pieces or in spliced lengths have proven very successful. In splicing this material I have always figured on a lap of six or eight feet. For lumber 10 inches wide I make the tongue 3½ inches. For holding the combined pieces of the sheet piling together I generally use ⅝-inch bolts at the top and bottom and at the splice, the balance of the length being held together by ⅝-inch boat spikes of the required length. As to the points used on the sheeting, ordinarily it was sharpened with a chisel point, equal amounts being cut away on either side. It is necessary, however, to increase or decrease the amount of sharpening done on each side of the sheet piling in order to draw it in the desired direction while driving. The lower forward corner of the sheet piling is usually cut away somewhat in order to draw the sheeting up to those already driven.

I have had very little experience with double lines of sheet piling. Where used, however, I find that puddle clay or black loam was quite satisfactory filling. In some cases where nothing better was available I have used fine sand with fairly good results.

In most cases I have used 3 x 10 inch pine for Wakefield sheeting, the tongue piece being dressed on four sides and the two outside pieces being dressed on one side and two edges.

Replying to question five, about driving sheeting:

I have used the ordinary track driver with drop hammer, roller driver with drop hammer, and scow driver with steam hammer. I have also used 8 x 16 inch timbers in the leaders of a track driver for the hammer, these timbers being as long as could be worked in the leaders. Ordinarily, however, the drop hammer used has been the usual iron hammer of 2,200 to 2,800 pounds weight. Usually a stroke of 6 to 15 feet is all that conditions require and the strength of the plank would permit.

Last year I put in a cofferdam in water varying from 6 to 12 feet deep. The bottom of the river was composed of sand covered with riprap and boulders. I found it impossible to rake this rock out of the way of the cofferdam. In order to get Wakefield sheet piling driven I used a steel track rail in the leaders of the track driver and drilled a channel through this rock for two or three feet in advance of where I was driving; then I would drive sheet piling in the channel, after which I would resume drilling for additional ones.

Where trees and rocks have been encountered in constructing a cofferdam, I have usually driven the sheet piling down onto the log and close up on both sides. If I was then able to pump the water out, I dug down and cut off the tree so as to drive a sheet piling past it. If that cannot be done I usually use a large chisel operated by block and fall for chopping the log in two. In some cases, however, where the trees or logs were simply on the bottom of the stream I have been able to get a hook or chain onto them and drag them out of the way. In such cases it was frequently necessary to use a hoisting engine pile driver or locomotive to do the pulling.

A. S. Markley, Supervisor B. and B., Chicago & Eastern Illinois Railroad:

In 1892 we had occasion to extend piers in Kankakee River bridge for building double track across that stream. Water at that time was three to five feet deep, current running three miles per hour; bottom of stream solid rock in courses of from 4 to 10 inches thick. After several attempts to maintain a dam with 2-inch plank, double thickness, with broken joints and clay outer wall, we were obliged to (on account of failure to keep water out) substitute Wakefield triple lap sheet piling, using gravel for outer wall, 6 inches deep around bottom end of piling. In preparing the Wakefield triple lap sheet piling for service we sharpened them the wide way, or parallel with the width of the plank on both inside and outside, leaving the sharp point in center of center stave. By doing so and driving them firmly onto the stone, the point adjusted itself to any uneven surface that might occur on the surface of the stone and prevented water from entering into the dam between the sheet piling and stone. Care was taken to prevent bruising the point or brooming it, and to hold piling up close to each other edgewise when setting it as well as driving, which was done with 20-pound hammer. This method overcame all of our former difficulties. When leaks occurred in joints of staves, a little coarse sand run down on outside over joint of stave soon closed and calked up the leak in the joint. Only one course of ship lap was used, made of 2 x 8 inch pine with 2-inch tongue and groove, which the center piece formed, nailed together with 30 D nails. Two waling pieces were used, 6 x 8 inches, flatwise, 6 inches from bottom of dam and 4 feet between them, halved together at corners and intermediate joints. Struts 8 feet apart, 6 x 8 inches, were used to hold waling pieces or sides apart. Vertical braces were used to hold dam waling pieces in position vertically until relieved by masonry. Piers being only 7 feet thick, no struts were required long way of dam; staves were used some eight or ten times. Occasionally one would break or get damaged by excessive use. Braces were nailed across all corners of waling pieces to further stiffen the dam laterally.

In clay or soil in shallow work, double thickness 2 x 8 inches, or 2 x 10 inches, driven with broken joints, is preferable for both easy placing and economy. When quicksand or similar material is found, Wakefield's is preferable and most practicable and economical. The former applies to 16 feet or less. Waling pieces should not exceed 4½ feet apart, 8 x 10 inches, halved together at corners and intermediate joints; joints scabbed on each side to insure stiffness, with 3-inch plank full width of timber, 3 feet long, corners thoroughly braced at 45° angle; girts 8 x 10 inches for 12 to 14 feet wide dam, 8 feet apart; first waling piece not to exceed 12 to 18 inches from bottom; shores of 4 x 4 inches between waling pieces set under each strut properly braced sidewise to maintain the distance. It is on rare occasions and under the most favorable conditions that wood staves can be driven to exceed 16 feet in depth.

In inserted dam sheeting should in all cases be Wakefield triple lap sheet piling in any class of material thoroughly braced same as upper section with 10 x 12 inch girts 8 feet apart, or at such distance as will prevent holding waling pieces in line. Character of material that surrounds the coffer dam must determine the size and number of pieces and the spacing.

Various methods are resorted to in driving sheet piling, depending on firmness and character of material. Usually an 8 x 10 inch piece, 5 or 6 feet long, 2-inch gas pipe, 3 feet long, passing through the ram to hold to, and top pointed for hand to grab to hold ram in line while driving, is used. Where this method fails pile driver with steam hammer and follower is applied; usually the weight of hammer alone serves the purpose.

F. O. Draper, Superintendent of Bridges, Illinois Central Railroad.

The blueprint herewith of cofferdams in detail shows the Wakefield sheeting in a large cofferdam, also the octagonal cofferdam for draw span piers and the detail of what we call the puddle wall. In addition to this I have designed the steel sheeting for the same steel cofferdam, giving the cost of both classes in place, showing the percentage of first cost between wood and steel, also the second cost of the steel sheeting, less salvage.

As a rule on deep cofferdams where Wakefield sheeting is used, there is but little of it, when taken out, that is in a condition to be used again; at least this is the experience of the Illinois Central R. R. We have also had a great deal of trouble with this style of cofferdam washing out at ordinary high water, and same has practically to be replaced as soon as the water goes down. This is due to not getting the sheeting down evenly, on account of the drift and small stone which causes it to lay unevenly at the bottom, hence a scour. This allows the pressure of the water to open it up and take same out in a body.

The steel sheeting on blueprint has never been used by our road, or on any road that I am aware of running out of Chicago, but I have looked into the matter and watched it very closely and think that railroads should adopt this style of cofferdam, as in the long run it would be a money saver. It is easier to put in place, being self-supporting and able to drive through any ordinary hard pan, through logs or drift, and can be put in place easier than Wakefield sheeting, pulls easier, and the joints are such that it makes an absolutely tight cofferdam.

The city of Chicago uses this sheeting, as do most of the contractors, especially Mr. Geo. W. Jackson, who is the maker of the steel sheeting shown on blueprint, and he uses it throughout all his work. I have looked over a great many of the jobs which he has been putting in, and find their cofferdams perfect in every respect.

I would recommend that this subject be discussed at our next meeting, with a view to having the railroads take up this style of sheeting, as Wakefield sheeting after having been used the first time is practically useless. There is no credit which can be given back to the job with this sheeting after it has been used once.

If any part of the steel sheeting becomes broken, making it unfit for use, it can be credited to the job as scrap steel at a good price.

The photographs herewith show cofferdams erected by Geo. W. Jackson in his work in and around Chicago, which will give you an idea of how they are put in and how supported. It will be noticed there is no piling used other than the steel sheeting, and that it is supported by waling and cross shores supporting the cofferdam as the excavation goes down.

The difference in cost of these cofferdams, classed in numbers, has been figured, from which can be gathered very readily the difference in cost between the Wakefield and the steel sheeting. On the plan there are two kinds of steel sheeting, but I would recommend as a cofferdam for all classes of work section of cofferdam with forged clips, being a 12-inch I-beam.

The comparative cost of these cofferdams is as follows:

Wakefield sheeting square cofferdam, $20.09 per lineal foot.

I-beams with channel separators, $40.34 per lineal foot for first cost, or 93 per cent more per foot than Wakefield sheeting. $28.71 per lineal foot less salvage, or 37 per cent more than Wakefield sheeting.

I-beams with forged clips, $32.73 per lineal foot for first cost, or 56 per cent more per foot than Wakefield sheeting. $22.71 per lineal foot, less salvage, or 9 per cent more than Wakefield sheeting.

Wakefield sheeting octagonal cofferdam, $24.91 per lineal foot.

I-beams with channel separators circular cofferdam, $36.36 per lineal foot for first cost, or 46 per cent more per foot than for Wakefield sheeting; $25.31 per lineal foot less salvage, or 2 per cent more than Wakefield sheeting.

I-beams with forged clips, circular, $28.96 per lineal foot first cost, or 16 per cent more per foot than Wakefield sheeting; $19.14 per lineal foot less salvage, 23 per cent less per foot than Wakefield sheeting.

Puddle wall sheeting square cofferdam for shallow water, made of plain sheeting, $7.08 per lineal foot.

I-beams with channel separators, $22.09 per lineal foot first cost, or 217 per cent more per foot than Wakefield or plain sheeting; $15.73 per lineal foot less salvage, or 122 per cent more than Wakefield or plain sheeting per foot.

I-beams with forged clips, $17.84 per lineal foot first cost, or 152 per cent more per foot than Wakefield or plain sheeting; $12.14 per lineal foot less salvage, or 71 per cent more than Wakefield or plain sheeting.

These figures for the puddle wall or shallow cofferdam run higher than the deep water cofferdam.

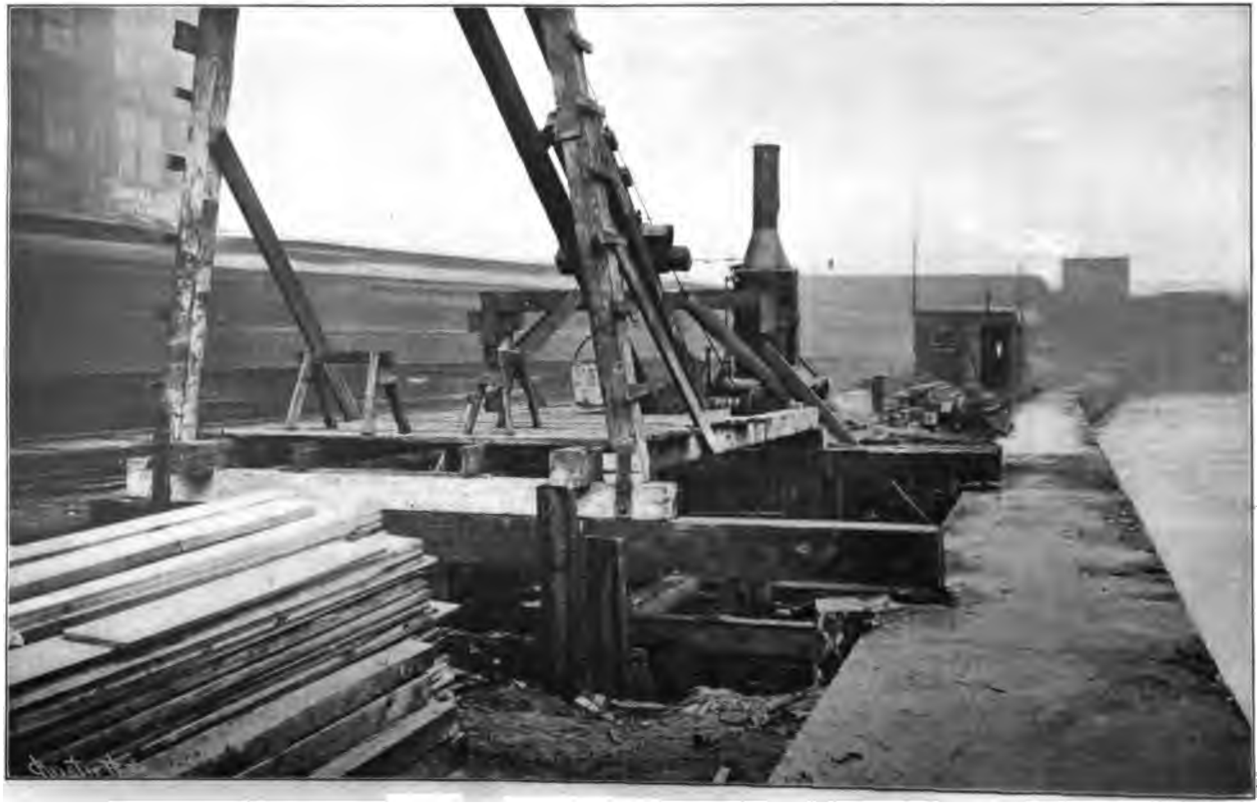


FIG. 69.—Disposal Station Tunnel Shaft, Chicago Ill.

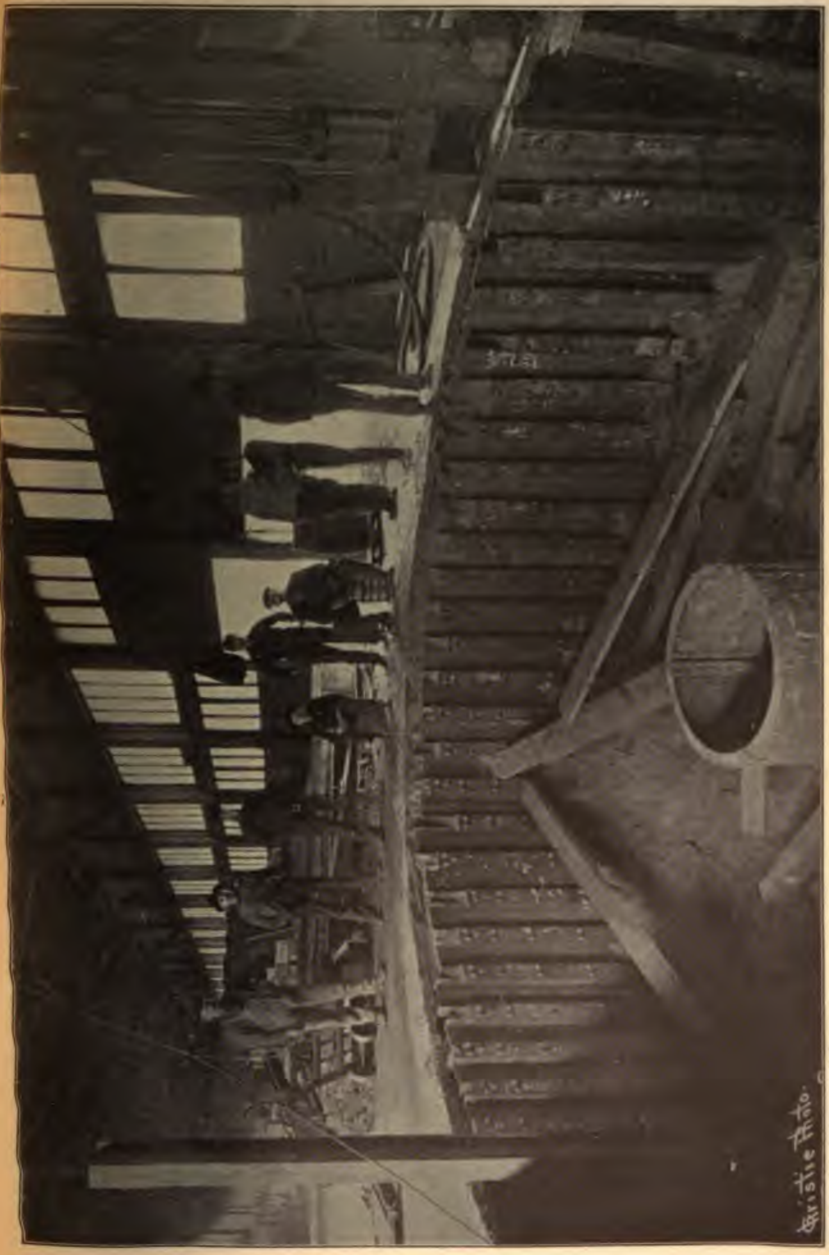


FIG. 70.—Steel Sheeting, Tunnel Shaft, Lake Shore Freight House, Chicago, Ill.

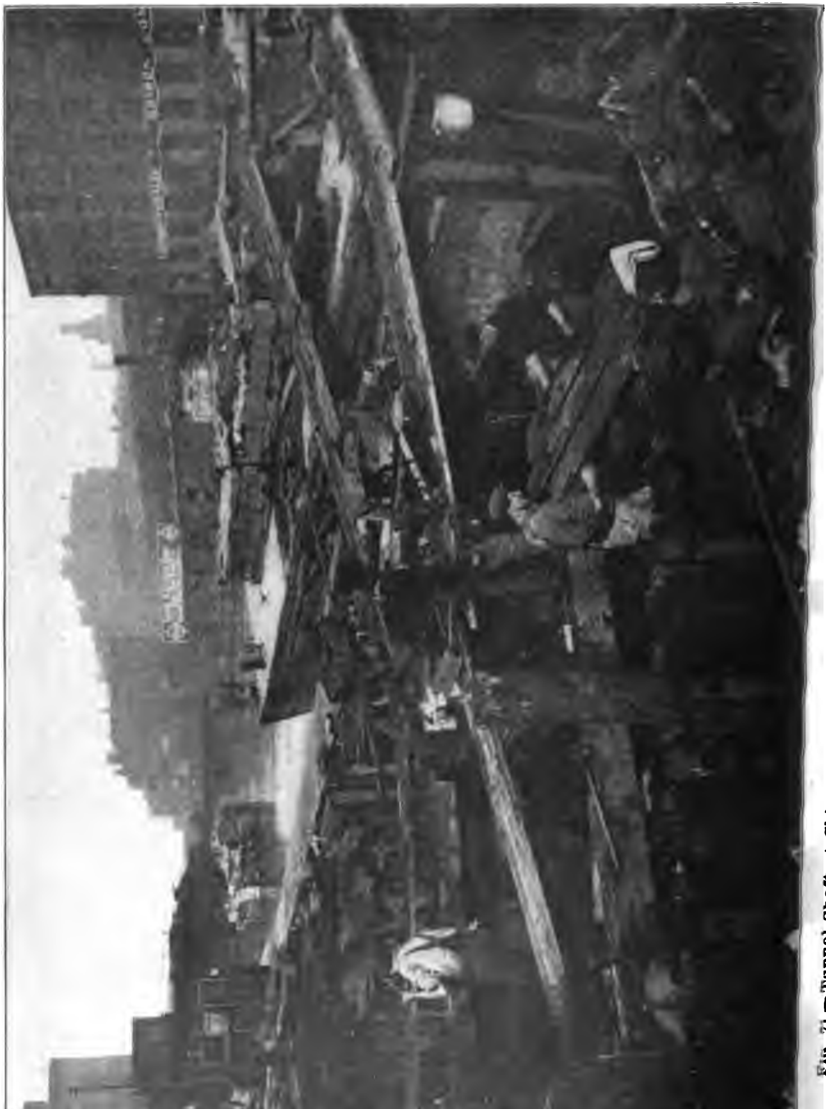


FIG. 71.—Tunnel Shaft at Chicago river, between Madison and Washington Streets, Chicago Ill.

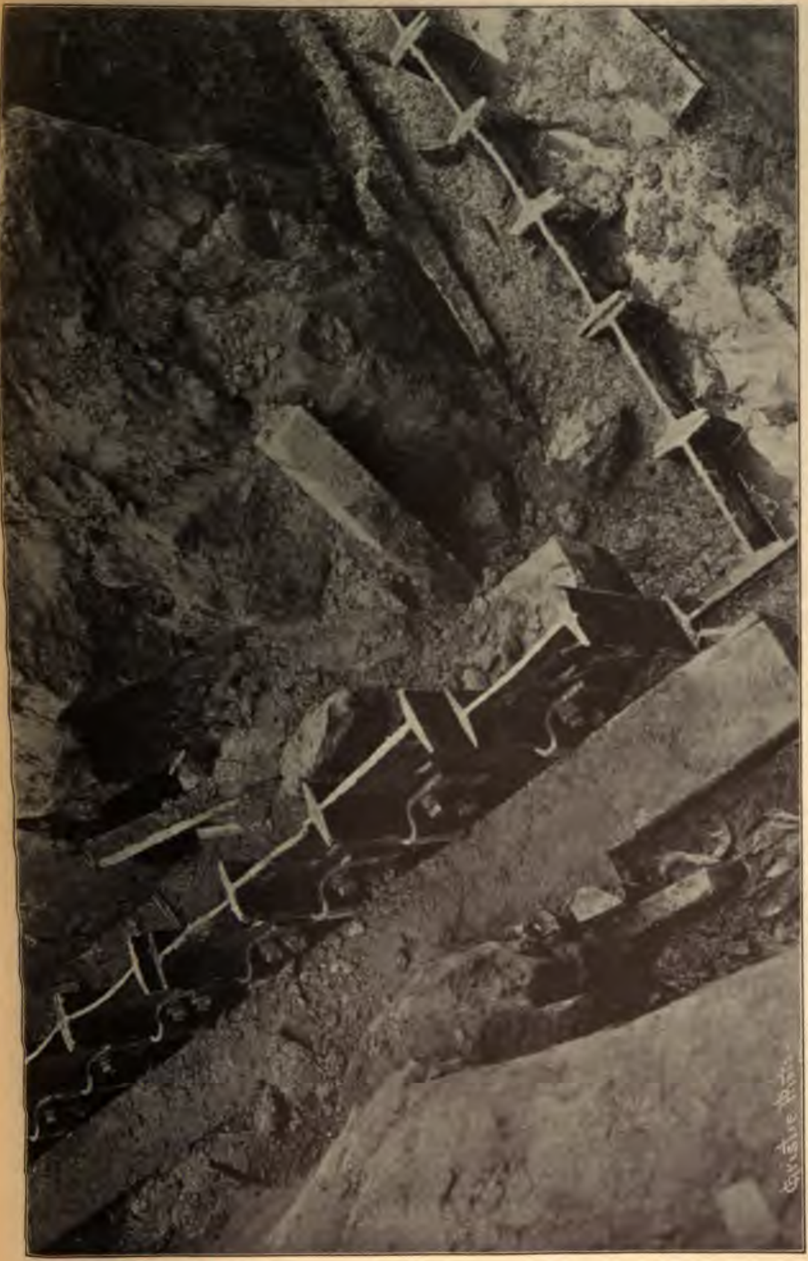


FIG. 72.— Steele-Wedeles Warehouse, Chicago, Ill. Steel Sheeting, corner detail.

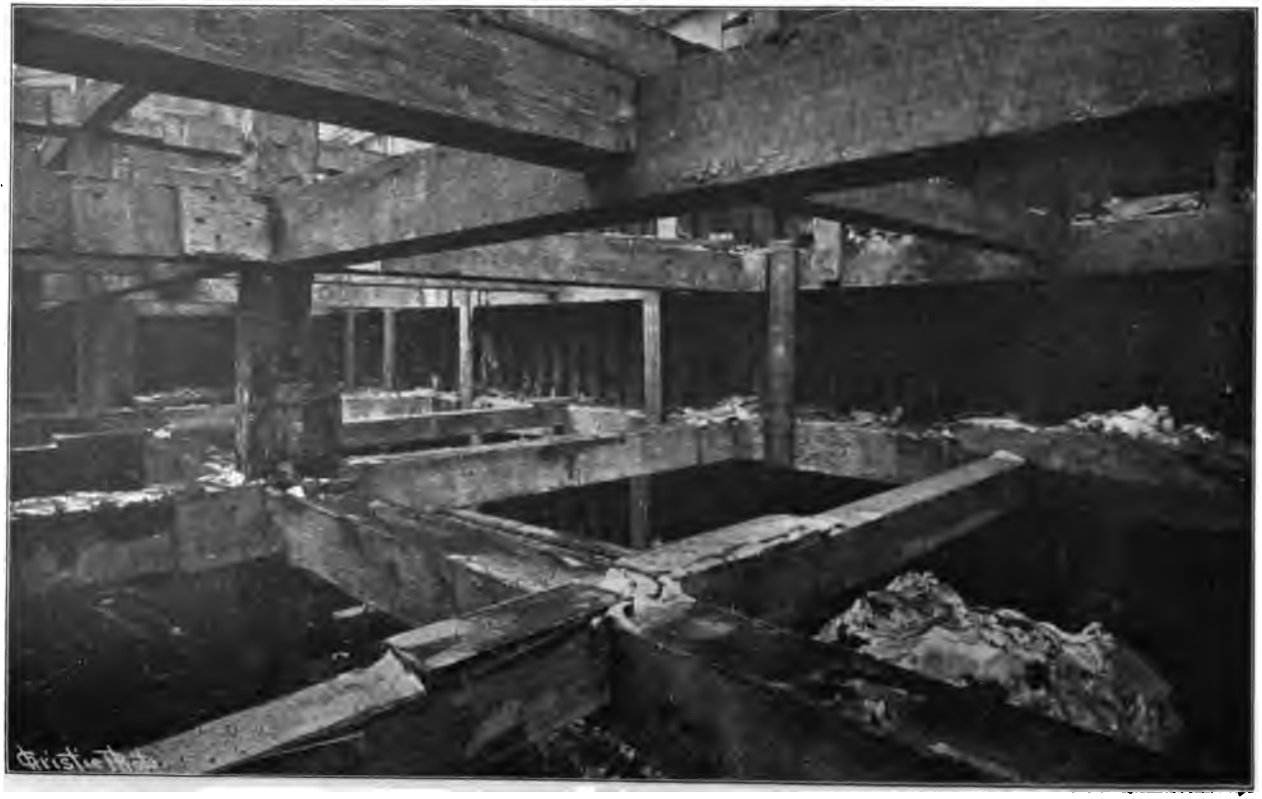


FIG. 78.-- Steel Sheeting, Sub-basement excavation, Steele-Wedeles Warehouse, Chicago, Ill.

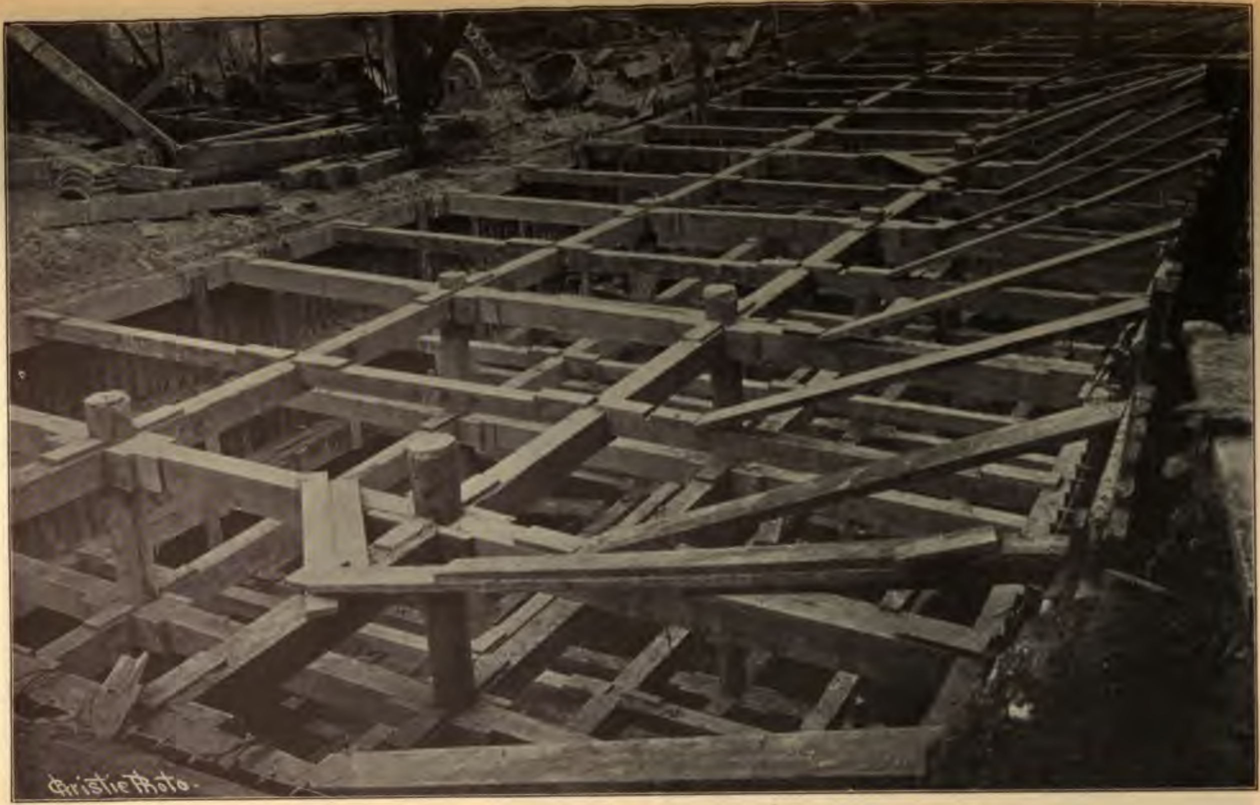
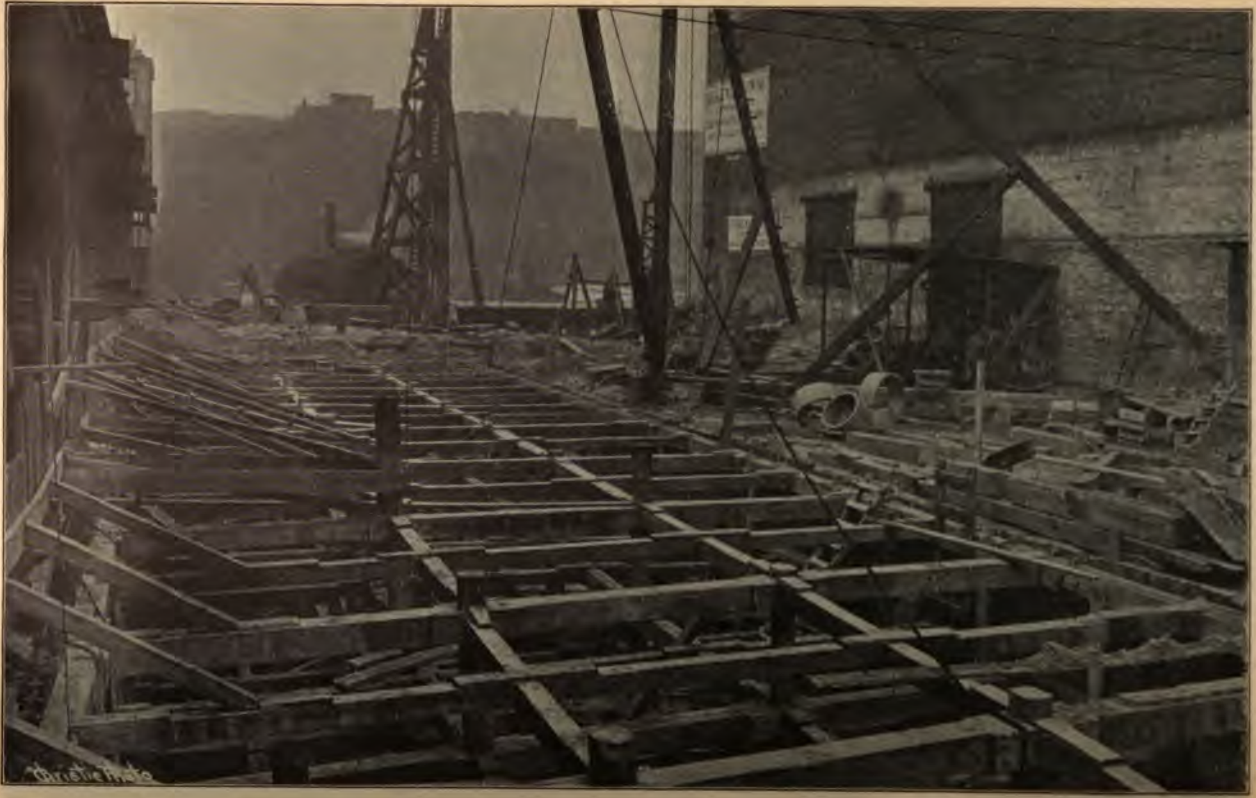


FIG. 74.—Steele-Wedeles Warehouse Foundation, Chicago, Ill.



Christie Photo

FIG. 75.— Steele-Wedeles Warehouse Foundation, Chicago, Ill.

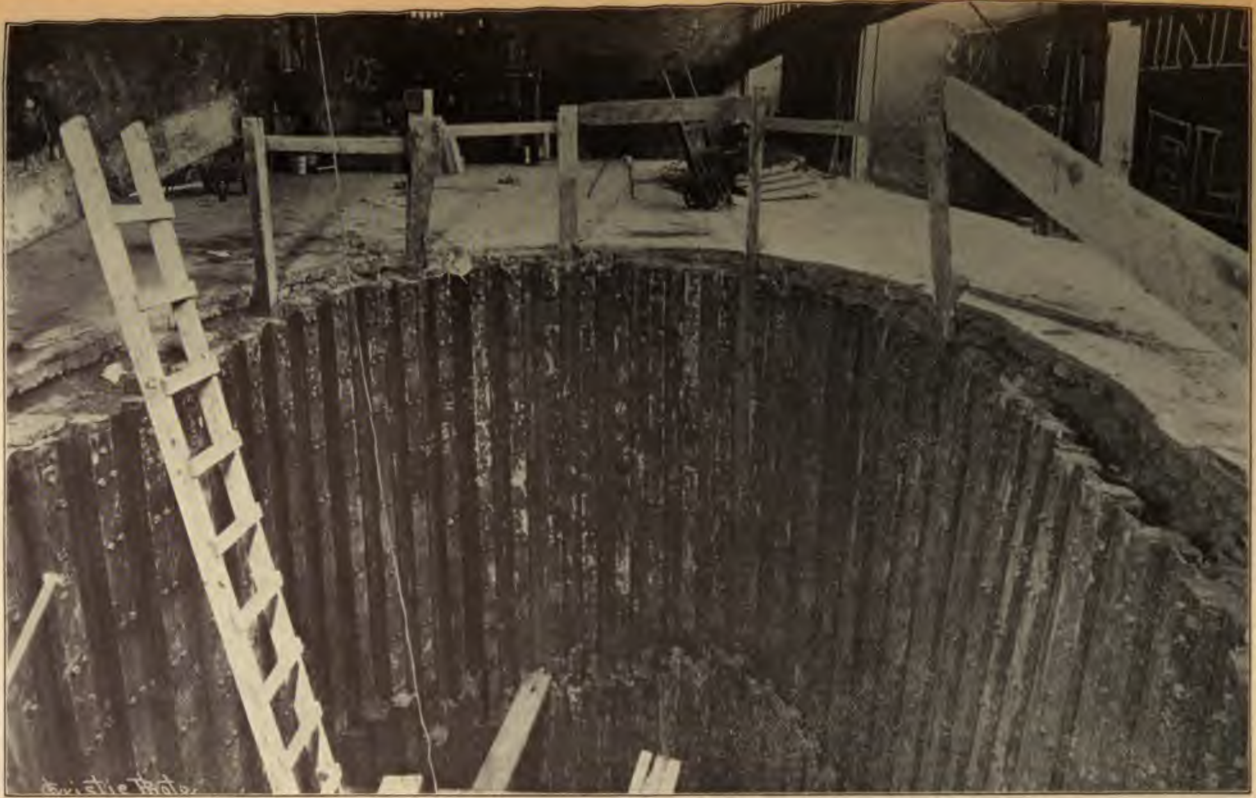


FIG. 76.—Steel Sheeting, Tunnel Shaft, B. & O. Freight House, Chicago, Ill.

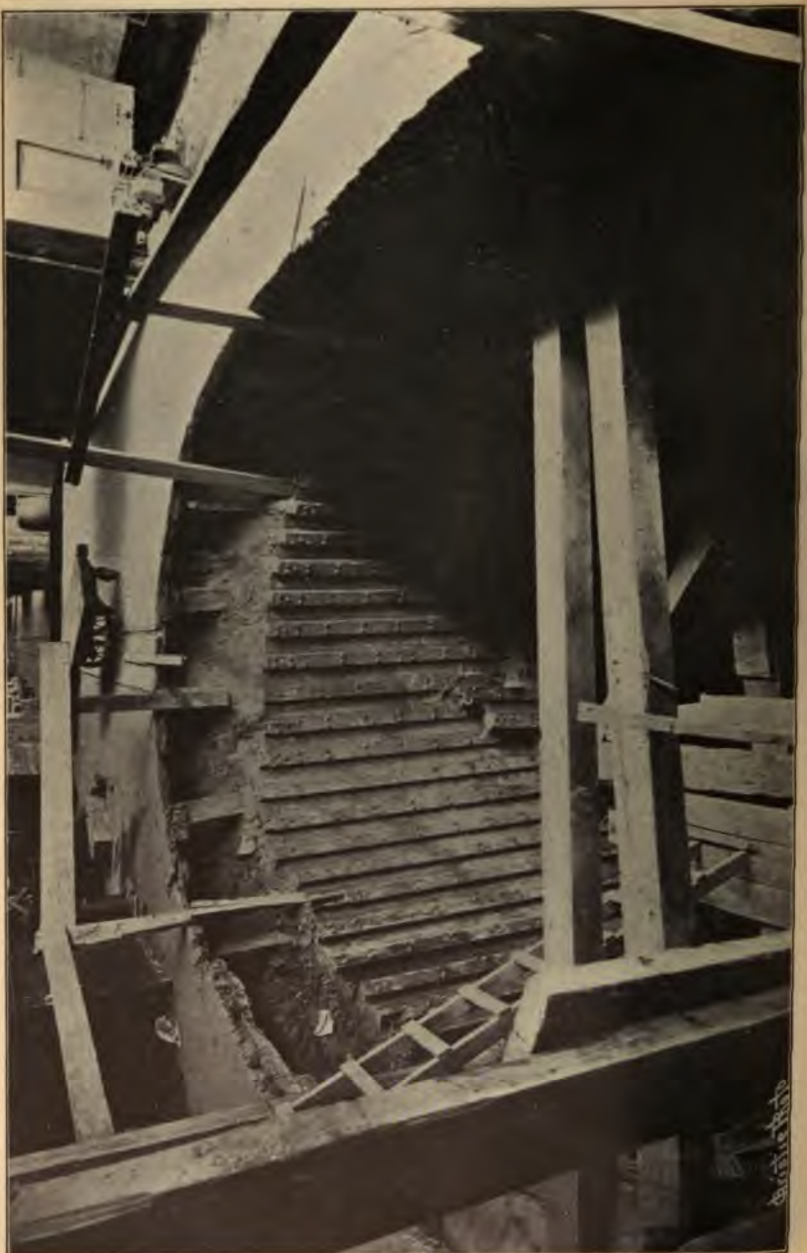


FIG. 77.—Steel Sheeting, Tunnel Shaft, B. & O. Freight House, Chicago, Ill.

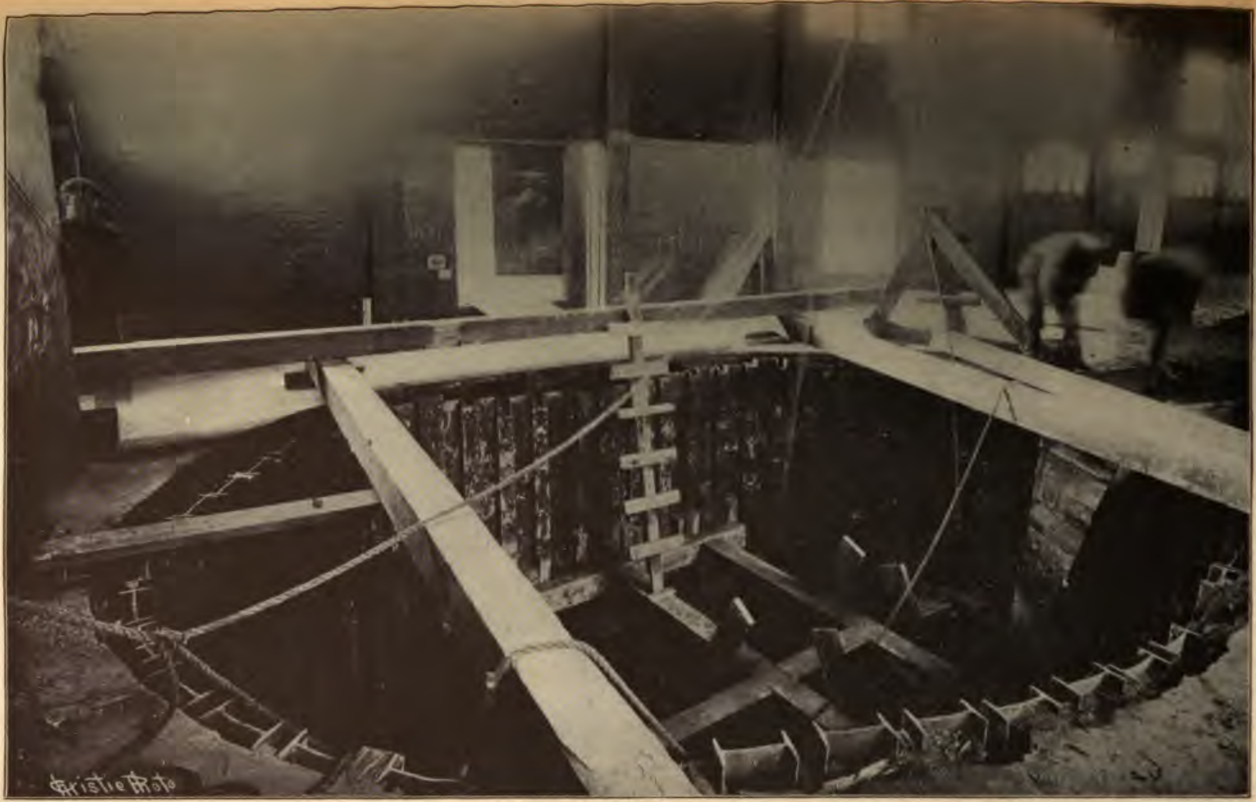


FIG. 78.—Tunnel Shaft, Lake Shore Freight House, Chicago, Ill.

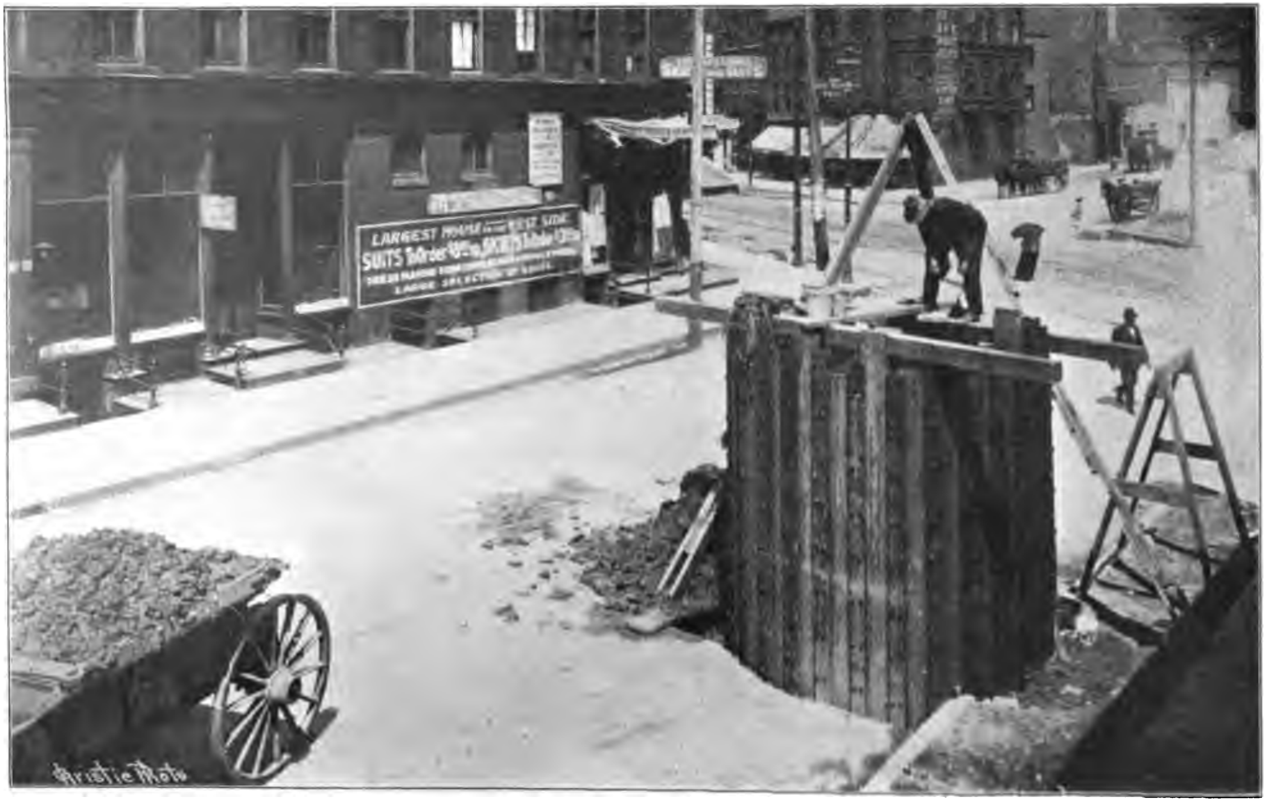


FIG. 79.—Steel Sheeting, Blue Island Avenue Water Tunnel, Chicago, Ill.

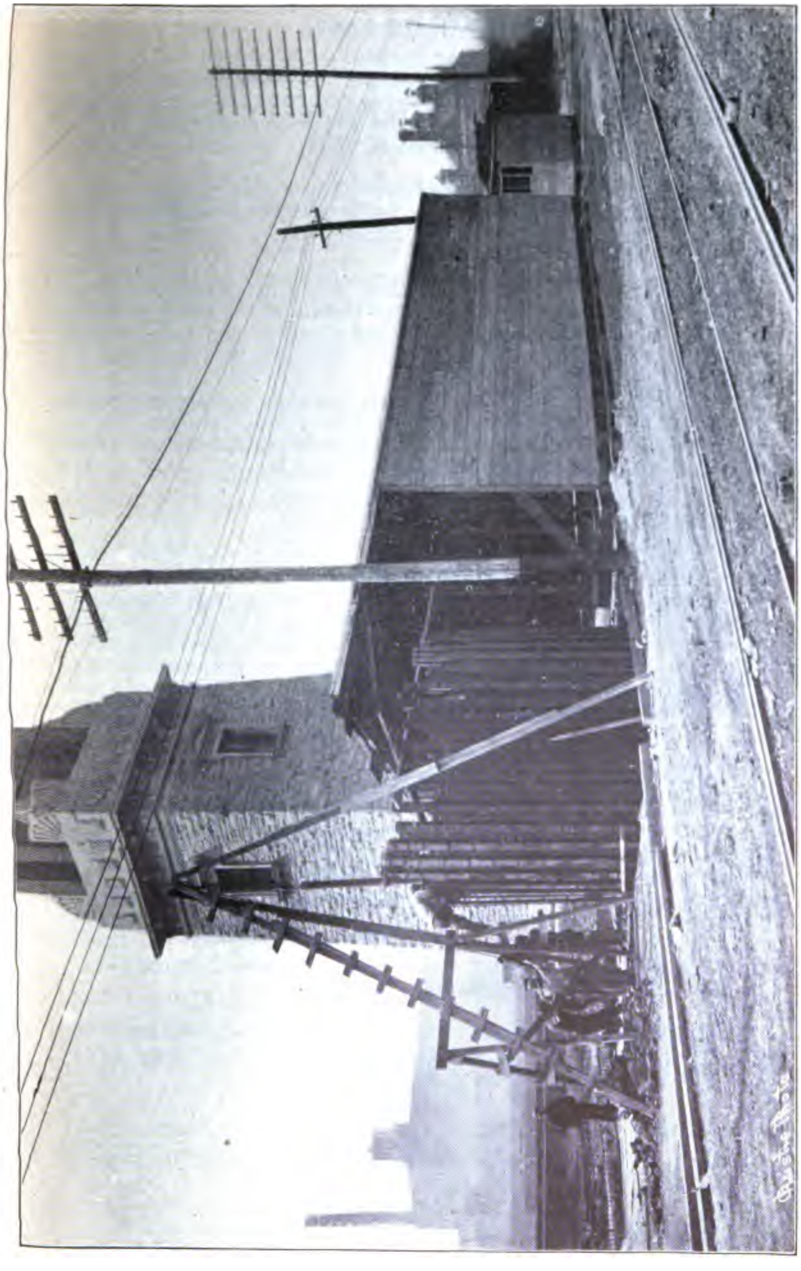


FIG. 80.—Blue Island Avenue Water Tunnel Shaft, Chicago, Ill.

However, I would recommend the steel cofferdam for all classes of cofferdam work, for the following reasons:

1. The best method of putting in shallow cofferdam of wood is to drive inside piles in line shape inside of cofferdam, leaving it the height above low water which is required, and start the waling on the outside as low down as possible and then start your Wakefield sheeting. This is easily driven with a hammer of about 2,000 pounds.

Steel cofferdam is self-supporting; will not need any piling to support it. Corners can be set at the proper point, and the sides and ends driven and the inside waling and shores put in as water is pumped out.

2. Size of waling timbers to be used in small cofferdams, 10 x 10s; large cofferdams 12 x 12s. I have shown on the print method of framing at the corners, and the distance apart, and the method of holding the waling is bolting them through the piles where wooden cofferdams are put in.

In steel cofferdams walling is set on the side and shored from the bottom until the horizontal shores are driven in tight. Perpendicular shores are put in to hold the walling and shores from settling until the second set of shores are put in.

3. Size of shores and struts for various depths, 10 x 10 and 12 x 12 spacing, as shown on blue print attached.

4. For shallow water sheeting staves I prefer the matched 1¾" S. 1. S. sheeting, with a lap side. This makes a double sheeting with broken joints. For deep water cofferdam for Wakefield sheeting use three-ply 3" S. 4. S. pine, framing the center piece to a groove and tongue; tongue to be 2½" extended and the groove 2½", with filling between. The outside line of sheeting should be at least 3 feet single line on the outside, double line on the inside. All the sheeting made of 3" material for this class of cofferdam.

5. My experience in driving this class sheeting is using a moving derrick driver with a set of short leads on the end of a boom, using a hammer of about 2,000 pounds weight, with a drop of from 7 to 12 feet. In driving in sand we usually use the water jet. This is in water 20 feet deep and over. My experience in putting in Wakefield sheeting through a bed of riprap is to put heavy sheet on and where we have drift and trunks of trees, use a 16" I-beam, drive it and cut the logs in two. This is the only method I have found satisfactory for getting Wakefield tin through drift. However, the steel sheeting shown on the plan here would overcome all this trouble of putting cofferdam in place.

The steel sheeting mentioned in this report can be obtained in sections of 42 feet. Any cofferdam deeper than that would have to be put in in two sections, one passing by another.

DISCUSSION.

D. L. McKee.—Our company is building a new bridge across the Ohio River at Beaver, Pa. The building of piers is being done by a Pittsburg contracting company. A wooden cofferdam is built in the usual manner, about 50 feet x 75 feet between inside walls. This enclosure being pumped out, a steel cutting shoe corresponding to the size of the pier is placed in position to build upon and form the bottom edge of the concrete caisson. Wood forms are then built vertically around the outer edge of cutting shoe, 30 feet high in sections of 10 feet each. The inside of caisson is formed by sheathing built up against the inner edge of cutting shoe and steping in and up until a thickness of 7 feet is reached on the horizontal, thus forming a 7-foot ring and filled with concrete. This ring or side walls is reinforced by two cross walls, 7 feet to 9 feet thick, located at about one third the distance of caisson from each end, leaving three openings on top of caisson for the purpose of removing dirt by clam shell and the operating of pumps or air if necessary. When caisson has reached the required depth by removing of dirt from underneath cutting shoe and has settled to the proper place, the caisson is filled with concrete. I merely mention this as it is a new method in our section of putting down foundations for piers and may interest some of the members on this subject.

Mr. Beahan.—To what depth below the water surface would the committee recommend that we sink a cofferdam before putting in the caisson?

Mr. A. S. Markley.—The depth depends upon the material you have to go through. We have gone 16 to 18 feet in a cofferdam without telescoping the cofferdam, by using shiplap casing. In 1896 we had occasion to extend our piers for double tracks. The bottom of the river is hard limestone rock in three or four feet of water. We first tried using a double casing three feet apart, filling in between them with clay, but found it impossible to keep the water out. After several attempts we finally resorted to Wakefield shiplap sheeting, first sharpening the point wedge-shaped, driving it down on the rock hard enough to batter, and sealing to the rock. In that manner we succeeded in putting down our dam. Wherever leaks appeared in the joints of our caisson, we would take gravel and let it run down the crack. Of course where there is quicksand and material of that kind, it is difficult to do, and depends on what success you have in driving down the shiplap. To take care of depth of 12 to 16 feet is as deep as it is possible to drive under almost any condition. When this depth is reached and it is impossible to drive farther, the only other method is to telescope the dam, that is, drive another line of sheeting inside far enough to the inside edge of whaling pieces to guide the sheet piling telescoped. The nature of material to be penetrated must be ascertained before starting, to insure getting cofferdam started large enough, with room enough in one end to set pump to take out water and sand. Centrifugal pumps will take out 30 to 50 per cent. of sand and other light material in suspension with the water it pumps out.

Mr. King.—Some years ago we had occasion to construct a cofferdam in about 22 feet of water. The bottom of the river was solid rock, with practically no gravel or sand. We used Wakefield sheeting sharpened to a chisel point and drove them hard enough to batter them. I did not see this cofferdam, but they told me it had hardly enough water in it to keep the pump going.

M. Beahan.—In my work with contractors, the engineers are always very anxious to put down a cofferdam, and in order to keep peace with the company, we have in many cases put down cofferdams where we could have put in a caisson for less money. We should certainly use the caisson more than we do, but it is a little expensive.

Mr. A. S. Markley.—In our part of the country there are few places where we would be justified in using the caisson. If we get our foundations down five to eight feet below the bed of the stream, we think we are safe against scouring.

Mr. Spencer.—In the streams in my country we have such extreme scouring that we have to go clear down to bed rock.

Mr. Steffens.—There is one point that I have not heard mentioned, and that is the size of the cofferdam. The common error is to get it too small. The question of increasing the size of footings as the work progresses frequently arises.

President.—Another point in favor of having your cofferdam a little larger is that in going down deep the tendency is to keep crowding in. Whatever changes take place are always inward. Then again if you have water to contend with there must be room on the inside for pumps. There are several points like that which make it desirable to have the cofferdam sufficiently large.

President.—As there appears to be no further discussion on this, we will pass to the next subject.

WOOD PRESERVATION BY THE OPEN TANK PROCESS.

By Ernest F. Hartmann, President Carbolineum Wood Preserving Co. of New York.

(Copyright 1908.)

Any discussion of the subject of wood preservation ordinarily begins with the causes of decay. This paper, however, is neither concerned with the causes of decay nor with the devastation following the destruction of our forests. Rot and decay are factors which must be taken into consideration by every engineer contemplating the use of timber for any construction work.

Wood preservation aims to preserve wood against premature decay. It goes further, however, for today its principal object is to make the short-lived and less durable varieties outlive the untreated long-lived species.

Applying the old adage that "an ounce of prevention is worth a pound of cure" to the subject of wood preservation, it should be borne in mind that vegetation has the effect of facilitating the decay of timber. Inferior ballast, and particularly material like sand, which will not dry out readily, is very injurious to the life of timber. Again, permitting decayed ties to remain on the right of way after they have been removed from the track is a very prolific source of decay. They should be burned to prevent their disseminating spores of fungus.

As an illustration of what can be accomplished with timber often considered waste, the following may be of interest: Until recently mining companies used broken gangway timbers and other waste only for fuel. At this time the Philadelphia & Reading Coal and Iron Company has installed twelve saws at their different collieries which cut up these broken timbers into slabs of sufficient length to be used for roofing, and this innovation is resulting in a profit to the company of nearly $3,000 per month. Other coal companies are following this example.

The initial step to secure longer life of timber is to use only such as has been properly seasoned. Air-seasoned timber is stronger, more durable and less subject to checking and splitting than green timber, and most woods recommended for treatment are also open grained, and, being more porous, can be air-seasoned by proper piling in comparatively short periods. Air-dry means reducing the moisture contents of the timber to about 20%, thus 80% of the food on which decay germs live are removed from the wood by proper seasoning. The risk taken when timber is held for air-seasoning as well as the interest charge on the investment is inconsiderable when compared with the saving represented by the increased durability and longer service of such timber. In Europe all timber, whether to be treated or not, is fully air-seasoned before use.

Too much stress cannot be laid upon the proper piling and seasoning of timber. Timber should always be piled so as to take advantage of all prevailing winds, taking into consideration the particular climatic conditions of the respective locality so as to prevent a too rapid drying and consequent checking and splitting.

The open tank method has developed a new form of seasoning, which enables the use of comparatively green timber by immersion in a bath of oil heated above the boiling point of water, and this is now becoming known as oil seasoning. An explanation of this will be given a little later. Wherever possible, it is advisable to use air-seasoned timber when employing the open tank process, because it will require a much shorter immersion in hot oil to drive off the sap and water.

Regarding the best preservative to use, there are various qualifications to be taken into consideration. Tar oils are today more widely used as preservatives than any other material, and the reason for this is found in the good results obtained by the use of same.

It can be definitely stated that it is the high boiling constituents of coal tar that remain in the wood and act as the preservative. *It has been definitely ascertained that the lighter and volatile oils disappear from the wood entirely within four years on timber fully exposed to the air.* Similar results were obtained on poles at the ground line, and ties have also been examined with practically the same results. The only exception has been piling submerged in water, and even here the high boiling oils were the principal factors that prevented decay. *The amount of penetration or rather the quantity of oil injected should for these reasons be no criterion on the assumed added life of the timber, without considering the quality of the oil used.*

The results of analyses and examinations made on timbers which had been perfectly preserved for periods of from sixteen to thirty-two years should convince every engineer of the necessity of definitely ascertaining the exact quality of the oil that is intended to be used for wood preserving purposes. At no time should the antiseptic requirements of the preservative be overlooked. These disinfecting elements should be of a nature permitting them to combine with the heavy oil, and thereby be rendered non-volatile; in other words, the two should be chemically united.

When using the open tank method where it is necessary to hold the temperature above the boiling point of water it is advisable to use a preservative containing few or none of the light oils, for when treating at temperatures only slightly above the boiling point of water, the ordinary commercial creosote will readily begin to volatilize.

The best preservatives for application in a concentrated form are obtained by the redistillation of tar oils by accurately gauged temperatures to secure that portion of the oil which contains the greatest amount of active principles.

While for ties the question of inflammability is of no concern, it becomes of considerable importance when the preservative is used on buildings, bridges, trestles, platforms, understructures, etc., and must therefore be carefully considered when drawing specifications for the preservative oil.

I believe that at all times it would pay to dip the bolts, spikes or nails in a good preservative before being driven and thus protect the surrounding wood against the attack of fungus. This will also to a large extent prevent the rusting of the spikes or bolts, thereby causing them to hold better in the wood.

The open tank process and the brush method of treatment can be adapted to all preservative requirements. Thus timber can be preserved at those points where decay is most likely to set in. As a process the open tank method has a great advantage over the pressure process in its adaptability to different forms of treatment. The penetration can be regulated with far more certainty than by any other method, and thereby an excessive and unnecessarily heavy injection can be prevented.

It is now well settled that the action of wood destroying agencies is mainly from the outside, and to this fact are ascribed the efficiency of certain preservatives which merely form a superficial coating over the surface of the timber. This is because such preservatives are poisonous enough to prevent fungi spores from developing on timber so treated and from entering into the untreated interior wood.

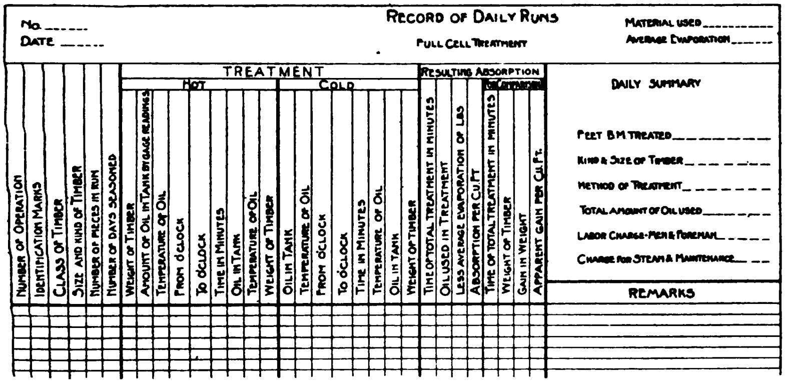
If then the timber is in proper condition to receive treatment, or has been sufficiently seasoned while in the hot oil bath, the penetration need not be very deep providing the preservative injected can prevent spores of fungi from obtaining any foothold and is stable enough to remain in the wood until the mechanical life of the timber is gone.

The open tank method obviates unnecessary expense for freight and handling of timber, for plants of sufficient size to care for the maintenance work of most roads can be loaded on flat cars and moved from place to place where it is most advantageous to pile the timbers and treat same. This advantage is of great importance to the members of this Association, for in the construction of freight houses, stock yards, coal bunkers, and so forth, it is much more economical to move a treating tank than it is to transport the timber to and fro. The open tank method enables the treatment of timber by the full cell process, if such is desired, or by variations in the method an empty cell treatment can be given.

Briefly stated, the theory of the process is as follows: "As the timber is immersed in a bath of preservative heated to a temperature above the boiling point of water, the air in the wood cells expands and the sap or moisture contained in the wood evaporates in proportion to the duration of the hot bath and also the temperature of same. The timber is then plunged into cold oil, which causes the air remaining in the wood to contract, forming a partial vacuum. To satisfy this vacuum the oil is drawn deeply into the wood.

We know that air occupies as high as 60 per cent. of the bulk of seasoned wood. According to the familiar law of physics, air expands 1-273 its volume for every degree C. that it is heated. Consequently when we heat the timber in the preservative from about 20 degrees C. to slightly above 100 degrees C., the air in the wood expands about one third in volume and, in forcing its way out of the wood, expels much of the moisture from the cell walls. This air rises to the surface of the hot preservative in the form of small bubbles, and the moisture leaves the oil in the form of vapor.

As a matter of fact a vacuum is also created by removing the timbers from the hot bath, the expanded air in the wood structure being contracted by contact with the colder air of the atmosphere and the oil then drawn deeper into the wood.



No. ------

Date ------

RECORD OF DAILY RUNS

FULL CELL TREATMENT

Material used ----------

Average Evaporation ------

						TREATMENT																	RESULTING ABSORPTION							
						HOT									COLD												FOR COMPARISON			
Number of Operation	Identification Marks	Class of Timber	Size and Kind of Timber	Number of Pieces in Run	Number of Days Seasoned	Weight of Timber	Amount of Oil in Tank by Gage Readings	Temperature of Oil	From o'clock	To o'clock	Time in Minutes	Oil in Tank	Temperature of Oil	Weight of Timber	Oil in Tank	Temperature of Oil	From o'clock	To o'clock	Time in Minutes	Temperature of Oil	Oil in Tank	Weight of Timber	Time of total Treatment in Minutes	Oil used in Treatment	Less average Evaporation of Lbs	Absorption per Cu. Ft	Time of total Treatment in Minutes	Weight of Timber	Gain in Weight	Apparent Gain per Cu. Ft.

DAILY SUMMARY

Feet B.M. Treated ----------

Kind & Size of Timber ----------

Method of Treatment ----------

Total Amount of Oil used ----------

Labor Charge-Men & Foreman ------

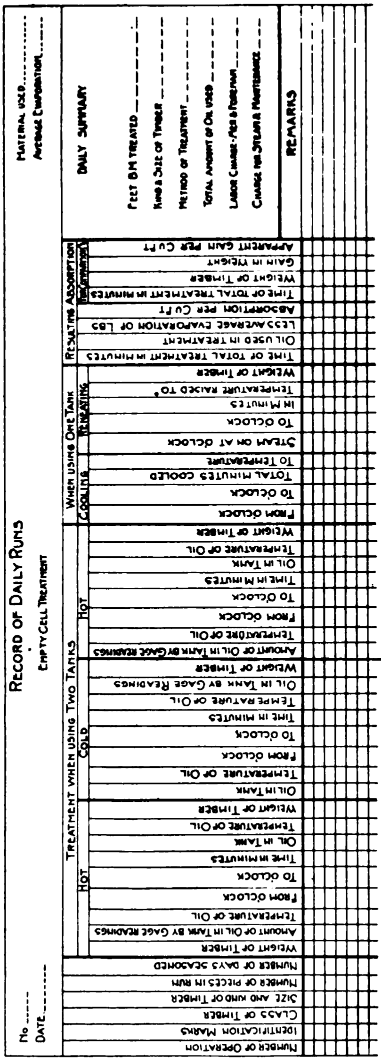
Charge for Steam & Maintenance ------

REMARKS

Fig. 81. — Daily Record Sheet for Full Cell Treatment.

From this and the next chart to be presented a fair idea of both the full as well as empty cell method of treatment can be obtained. In preparing these charts it has been my endeavor to cover all steps necessary to secure the most accurate results possible, the object being primarily to give a basis for a form of sufficiently complete record of all treatments. Many of the subdivisions will undoubtedly be eliminated in actual practice, but they are presented for the purpose of enabling every engineer to arrive definitely both at the cost of treatment as well as the resulting absorption.

Figure (2) represents a form of record sheet for the empty cell treatment, and is subject to such changes as may be called for by conditions. At all events, only a part of this record sheet would be used, for the treatment would either be hot, cold and hot, and then would follow the summary, or it would be heating, cooling and reheating with the resulting absorption. In this method the retreating in hot oil or reheating of the oil causes a diffusion of the oil through a greater area without the use of any additional preservative.



No -----
Date --------

Record of Daily Runs

Empty Cell Treatment

Material used ------------
Average Evaporation ------

Treatment when using Two Tanks																									When using One Tank									Resulting Absorption							
						Hot									Cold								Hot								Cooling				Reheating									(For Comparison)			
Number of Operation	Identification Marks	Class of Timber	Size and Kind of Timber	Number of Pieces in Run	Number of Days Seasoned	Weight of Timber	Amount of Oil in Tank by Gage Readings	Temperature of Oil	From O'clock	To O'clock	Time in Minutes	Oil in Tank	Temperature of Oil	Weight of Timber	Oil in Tank	Temperature of Oil	From O'clock	To O'clock	Time in Minutes	Temperature of Oil	Oil in Tank by Gage Readings	Weight of Timber	Amount of Oil in Tank by Gage Readings	Temperature of Oil	From O'clock	To O'clock	Time in Minutes	Oil in Tank	Temperature of Oil	Weight of Timber	From O'clock	To O'clock	Total Minutes Cooled	To Temperature	Steam on at O'clock	To O'clock	In Minutes	Temperature Raised to°	Weight of Timber	Time of Total Treatment in Minutes	Oil Used in Treatment	Less Average Evaporation of Lbs	Absorption per Cu Ft	Time of Total Treatment in Minutes	Weight of Timber	Gain in Weight	Apparent Gain per Cu Ft

Daily Summary

Feet BM treated ----------
Kind & Size of Timber ----------
Method of Treatment ----------
Total Amount of Oil used ----------
Labor Charge-Men & Foreman ----------
Charge for Steam & Maintenance ----------

Remarks

Fig. 82.—Daily Record Sheet for Empty Cell Treatment.

The ordinary method of computing the absorption is to weigh the timber both before and after treatment. This, however, is very unfair when the theory of this process is borne in mind. Even room-dry timber contains 10 per cent. of water, and this must be considered.

Actual absorption is obtained by computing the oil used in treating less average evaporation for same period of time, and dividing actual amount of oil used by cubic feet of timber treated, but even this is not accurate unless readings are taken at same temperature.

The success of treating merely in hot oil can be largely ascribed to the removal of the sap and water from the timber by this form of treatment, which, while not giving a heavy penetration, insures the preservative reaching all cracks, checks or splits already in the timber, and again for the reason already stated, that a superficial treatment with a sufficiently antiseptic oil will prevent decay germs from developing.

To refer again to oil seasoning. In the open tank method, when treating above the boiling point of water, the sap and water contained in the wood are vaporized, and this is well illustrated by weighing a piece of wood before and after being treated in the hot bath, when it will be found that the wood weighs less than before treatment. This of course will not apply when seasoned timber is treated.

By the open tank method any desired depth of penetration can be obtained by varying the length of duration of the hot and cold bath, though the depth of penetration is principally regulated by the duration of the cold bath. If the timber is removed from the cold preservative before the vacuum has been completely destroyed, it will upon removal from the bath leave the surface of the timber clean and dry.

There are many advantages of the natural vacuum or open tank process which time will not permit of presentation here. Among the principal ones, however, I will mention:

1. The treating outfit may be located at the most convenient point for handling the timber and carrying on the treating work, thus saving the expense of at least one handling of the timber. A plant may even be rigged so that it can be transported at very small cost from place to place.
2. Ability to treat only such portions of the timber as will be most likely to decay, as for instance, butts of posts or poles, and also giving a heavier treatment on the cut ends of timbers where decay is most likely to set in.
3. Minimizing the cost of treating operations by doing the work during spare hours when the men are not otherwise employed.
4. Taking into consideration the funds available for treatment or if only a moderate treatment is desired this method is sufficiently flexible to permit of application.
5. The simplicity of the method enables its use for the smallest amount of maintenance work as well as for the most extensive new construction work.
6. Timber can be treated at a minimum cost to obtain the maximum mechanical life.
7. As a method it permits the benefits of wood preservation to be extended to industries where some preservative method is desired but for which the vacuum processes are too elaborate and expensive.

A brief reference to brush treatment could hardly come amiss at this time. It is of great value when no other method can be used, as for instance in treating the cut ends of timbers, joints, mortises, points of contact, etc. Again, for structures already erected it is much more reasonable to apply a coating of a good preservative than a mere coating of oil paint.

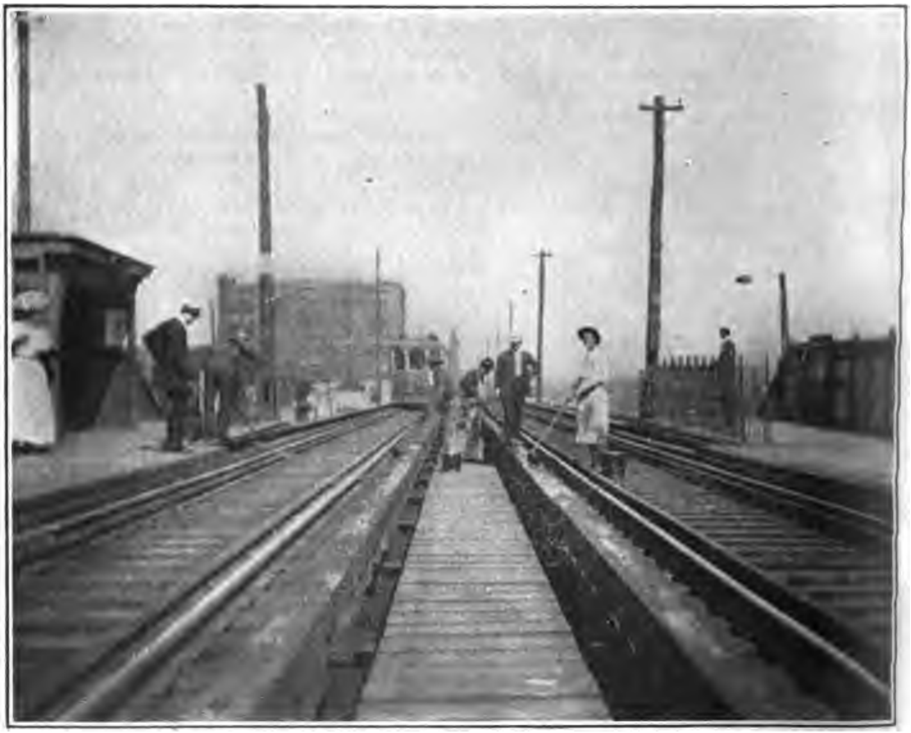


FIG. 88.— Showing application of Avenarius Carbolineum by the brush to completed trestle.

The illustration presented is the elevated structure of the Public Service Railway Co. at Hoboken, N. J., the preservative being applied in a heated state. The operatives use long-handled brushes and run the oil well in at all cross-cuts.

At former meetings of this Association some of the members discussed their use of the brush method of treatment, and with special reference to its use on open pile trestles and bridge work. I refer particularly to the proceedings of the 16th annual convention.

From a paper prepared by Mr. Martin Schreiber, member American Society of Civil Engineers, I quote: "All practical men know that many times lumber is introduced on structures with the intention that it shall be only temporary; often the work becomes a permanent fixture. Again, timber structures are sometimes adopted on account of their flexibility and advantage at the time of installation, so that, in using lumber, and not having anticipated the work, we would not have the time required to convey it to and fro to a preserving plant, which may or may not be at a considerable distance away. On the other hand, it may not be desirable for a large increase in percentage of life of structure, or perhaps it is necessary to preserve only part of the timber. The disadvantages referred to have demanded a simpler, cheaper and easier method of treatment, and this has been accomplished by the adoption of what is known as the open tank method."

In the treating outfits which are now to be illustrated, steam is always used for heating the preservative unless otherwise stated.

The first open tank used by any railway company of which I have been able to obtain some definite record was that of the Columbus (Ga.) Railroad Co., who in 1891 commenced the treat-

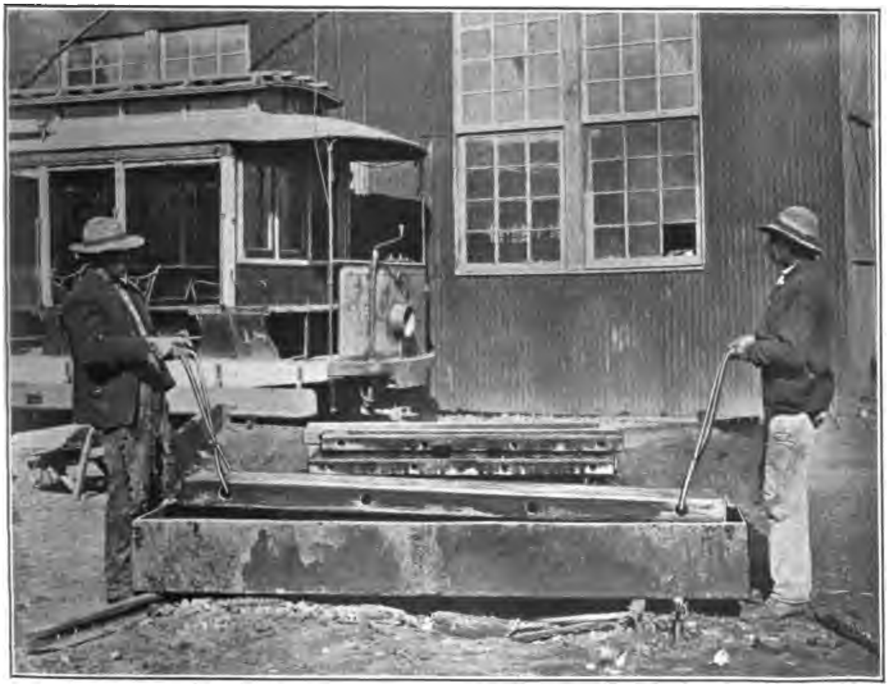


FIG. 84.— Using an ordinary wood fire to heat the saturation tank.

ment of their ties. The oil was heated in a tank shown in Figure (4) by means of a wood fire, old ties and waste being utilized for fuel. Cross-arms have also been treated in considerable quantities for the Columbus Power Co. The cost of such a treating outfit is very small. It holds two ties at a time, which are immersed in the oil for ten minutes. They are then thrown upon an iron dripping plate, after which they are piled to dry before receiving the second treatment, care being taken in the second dip that the timber is completely submerged and immediately removed. After draining they are stacked ready for use.

Mr. Reidhead, until recently the manager of this company, advises that the complete cost of treatment per tie was 31 cents, making a total cost of $9.68 per 1,000 feet B. M.

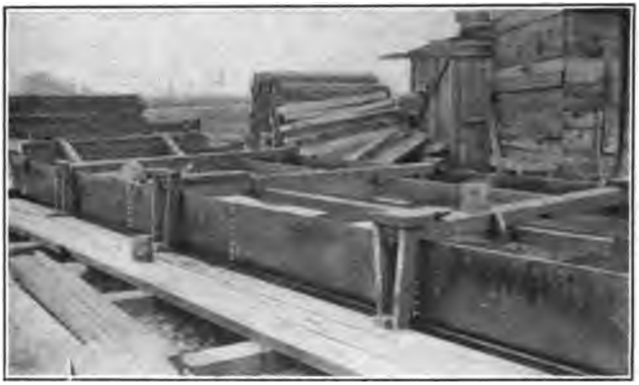


FIG. 85.—Tank with cross timbers for holding down the ties during treatment.

The Boston Elevated Railway Co. in 1897 began the treatment of ties, and are now using the treating plant shown in Figure (5). They have treated approximately 90,000 ties, including tamarack, chestnut, oak and hard pine, 7 feet x 8 inches x 6 inches, and the treatment has cost them from 15 to 17 cents per tie, making a cost of $5.71 per 1,000 feet B. M. This tank is 18 feet long, 4 feet wide and 5 feet deep, made of ⅜ inch boiler plate. A 1½ inch steam coil is used. Bundles of 10 or 20 ties are handled by the derrick shown in the picture, the capacity of the plant being from 600 to 800 ties per day. Mr. Plympton advises: "We do know that it greatly prolongs the life of the ties. In our reservation tracks where part of the ties have been treated, when it was necessary to renew the rail we were able to use over again the ties that had been treated, while those that were untreated were not fit to remain.

Figure (6) represents the first tank installed by the Norfolk & Portsmouth Traction Co., in which cross timbers were used to hold down the ties.

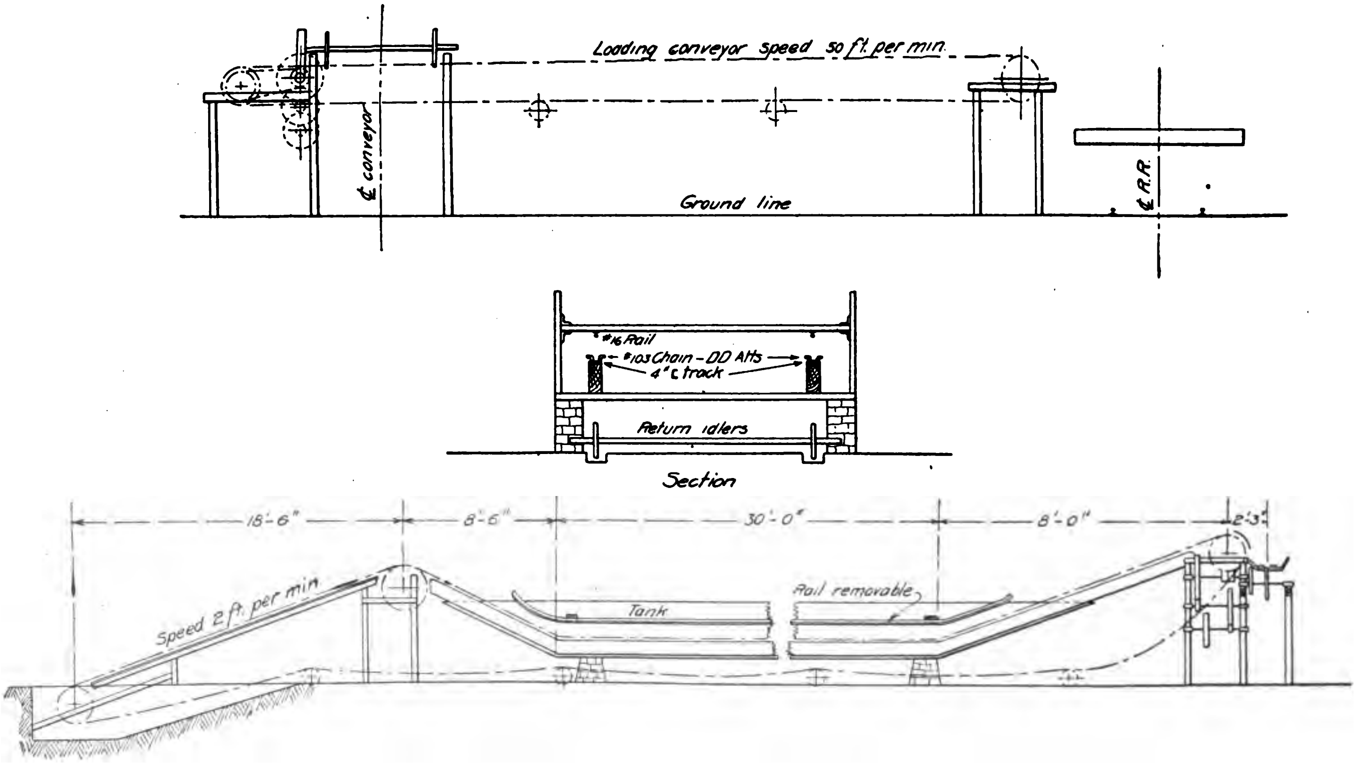


FIG. 86.—Conveyor for handling ties used by the Norfolk & Portsmouth Traction Company.

Figure (7) shows the conveyor chain arrangement as worked out by the engineers of this company. The tank, which is 30 feet long, 10 feet wide and 24 inches deep, is made of ¼ inch steel plate with 2½ inch angle iron corners, and cost $300, F. O. B. Norfolk. The conveyor chains cost $450, and the capacity of a plant so arranged is 1,000 ties per day. By using movable rails to hold down the ties, this tank can be used for bridge and trestle timbers. The cost of treatment, including labor, steam, etc., was 23 cents per tie, making a total cost of $7.20 per 1,000 feet B. M.

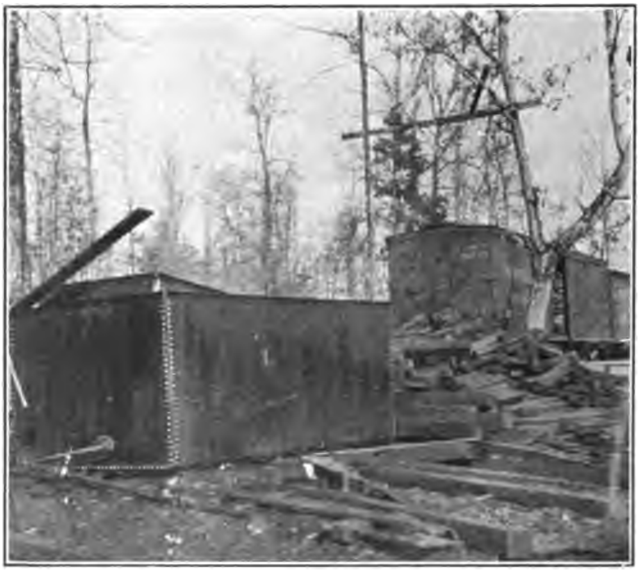


Fig. 87.— Double tank, the outer tank containing steam heated water for treatment of cross arms.

A double tank equipment for treating cross-arms, erected by the Southern Power Co. of Charlotte, N. C., under the direction of Mr. Frazer, Assistant Chief Engineer. The inner tank is 4 x 8 x 3 feet, and is surrounded by a second tank 5 x 9 x 4 feet deep, filled with water heated by a steam pipe from a boiler set up for other purposes. Both tanks are made of 3-16 inch steel plate and stiffened around top and bottom with 2-inch angle iron. The cross-arms are 4¾ x 5¾ inches x 7 feet long, treated for fifteen minutes in oil at a temperature of 65° C., and absorbing from three to six pounds of the oil.

For this drawing I am indebted to Mr. J. N. Cartwright, Jr., the treasurer of the Bangor Railway & Electric Co., who have treated some 8,000 spruce cross-arms in this tank. The cost of the treatment, including the price of the galvanized iron lined

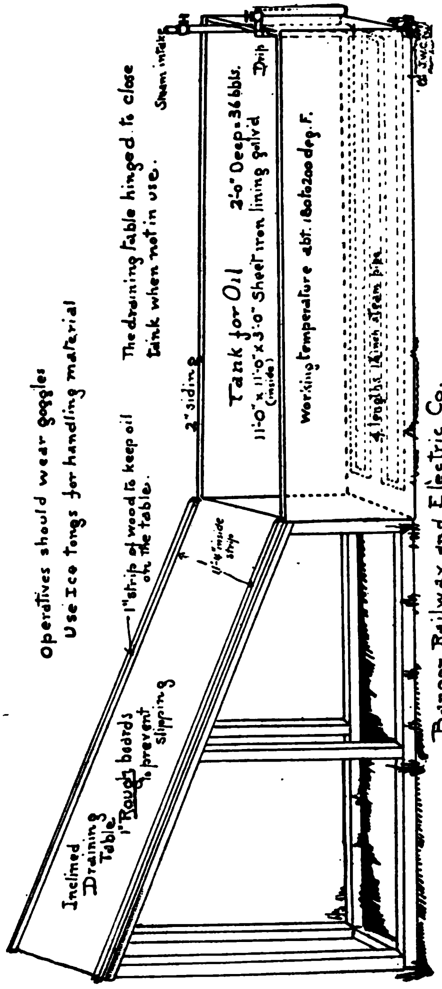

Operatives should wear goggles
Use Ice tongs for handling material
The draining table hinged to close tank when not in use.
Steam intake
1" strip of wood to keep oil off the table.
2" siding
Tank for Oil
11'-0" x 11'-0" x 3'-0" (inside)
2'-0" Deep-36 bbls.
Sheet iron lining galv'd
Drip
Working temperature abt. 180 to 200 deg. F.
4 lengths 1¼ inch steam pipe
1¼" inside strip
Inclined Draining Table
1" Rough boards to prevent slipping
Bangor Railway and Electric Co.
Used for dipping crossarms up to 10 ft long—7500 dipped 1907.
Could be used for ties in small quantities.

FIG. 88.—Drawing of plant used by the Bangor Ry. & Electric Company.

tank, 12 feet square and 3 feet deep, was 12¾ cents for 10 feet cross-arm, or a cost of $7.66 per 1,000 feet B. M. The cross-arms are placed in the tank until they will float no more, then left 10 minutes in the hot oil, after which they are placed on a draining table shown in the drawing.

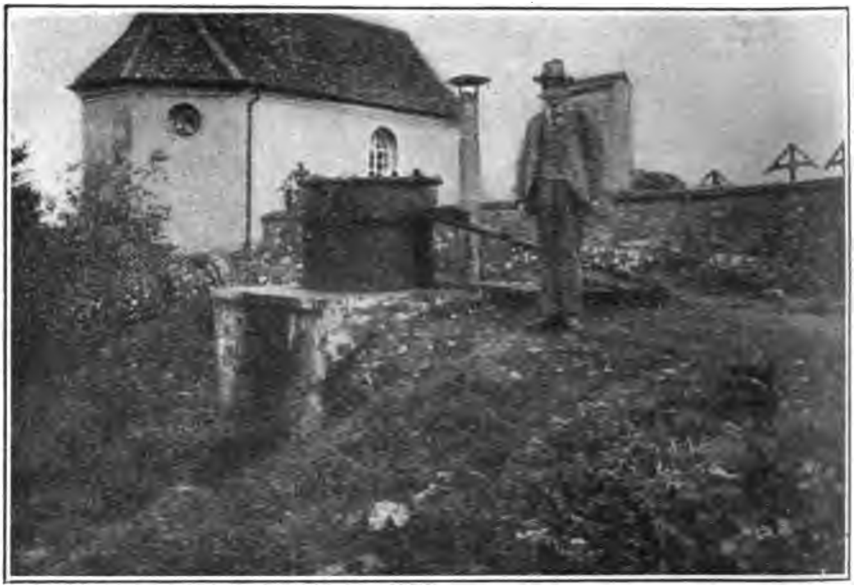


FIG. 89.—A handy arrangement for treating fence posts on side of a hill, using a wood or coal fire below the tank.

A tank for treating fence posts, arranged on the side of a hill so as to simplify the method of handling the posts. It further enables the use of a coal or wood fire below the tank. This method was first used in the wine-growing sections of Germany in the early seventies, and is still being used with good results.

View of open tank in use at English mines for treatment of mine props. Treatment lasts from ten minutes to half an hour, the oil being heated to 100° C. The first plant of this kind was installed in England in 1901.

The Consolidated Coal Co. of Saginaw, Mich., use an open tank in which they have treated props and timbers for the entries and buildings during the past five years. As stated by their general manager, Mr. Randall: "The expense of retimbering under the union scale of wages in the mines is very large, and therefore we feel it is economical to treat the timber, and we have treated on idle days with men whom we were obliged to have around the mines. Timbers treated have never shown any signs of rot so far, while untreated timber has to be replaced in from one to two years.

This tank has been variously used for the treatment of flooring, etc., but was particularly erected for the treatment of bridge timbers. It was first used in 1890, and shortly after that was used for the treatment of considerable quantities of lumber for

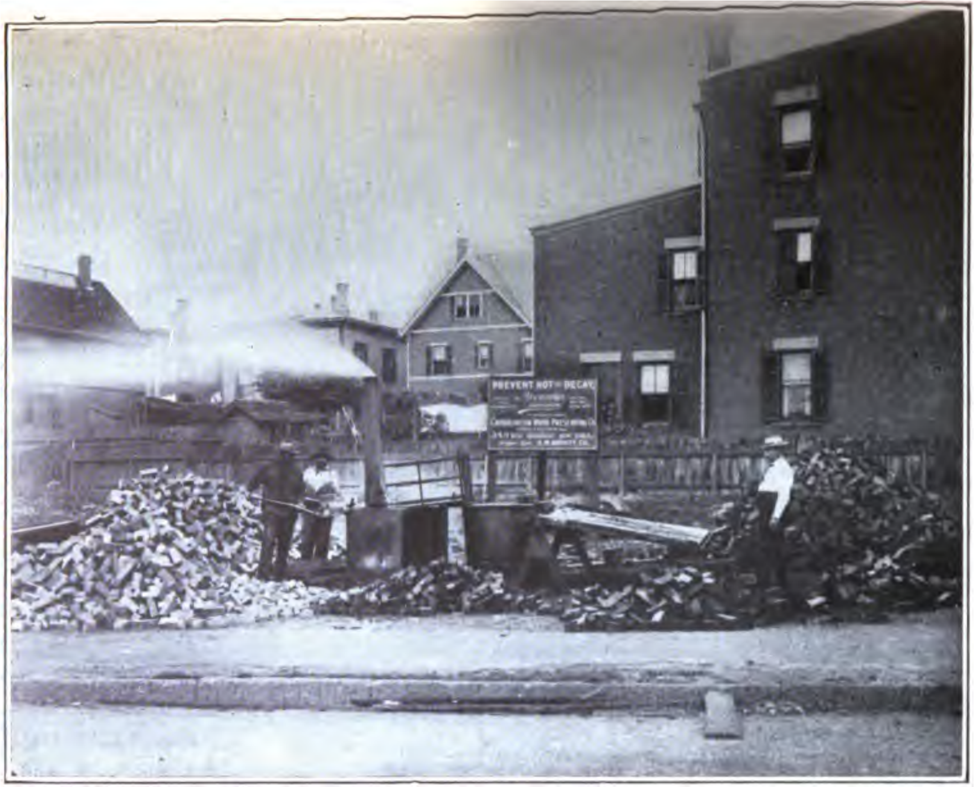


FIG. 90.— Outfit used for treating paving blocks by natural vacuum process.

tanneries where flooring and other timbering is exposed to very severe conditions. During the past year the sills, joists and flooring of the 16th Street viaduct in Milwaukee as also the timber for the North Avenue viaduct in the same city were treated in this tank, the preservative being heated by means of an open fire below the tank, although at the 16th Street viaduct steam coils were used.

In this tank the Peerless Motor Car Co. of Cleveland, Ohio, treated 150,000 feet of flooring, sills and joists during the last three years, at a cost for treatment of $9.00 per 1,000 feet B. M. This tank cost $30, is 20 feet x 3 feet x 3 feet, lined with galvanized iron, using 1¼ inch pipes lengthwise for heating the oil.

The Automatic Shovel Co. of Lorain, Ohio, two years ago built a tank at a cost of $5, in which they treated 45,000 feet 2-inch plank at a cost for treatment of $9 per 1,000 feet B. M.

Westinghouse, Church, Kerr & Co. treated by the open tank method all the flooring, sills and joists used in the construction of the extensive buildings for the Railway Equipment Co. of Chicago. A portable plant was rigged up, the tank being 21 feet long, so as to enable the treatment of the longest timbers.

Tanks of this kind were first used in 1890 for treating the paving blocks laid on Trafalgar Square, London. The blocks for Northumberland Avenue, Charing Cross and many other streets of the west end of London were treated with a similar outfit. The tank itself is 4 feet x 4 feet x 4 feet deep. Blocks are 9 inches x 5 inches x 3 inches, and 1,000 of them absorb 10 gallons of the preservative.

Figure 90 illustrates a block treating plant using hot and cold treatment, the blocks absorbing 27 gallons per 1,000 feet B. M. The hot tank was a square roofing kettle, with a capacity of 200 blocks, 3 inches x 3 inches x 8 inches. Old ties were used as fuel to heat the oil.

The city of Cleveland installed this treating outfit which, complete with steam pipes, etc., cost $125. At the present time pine plank and 5-inch blocks for paving the Abbey Street viaduct are being treated in this tank. The cost to them is $2 per 1,000 feet B. M. for handling the lumber, and they are using 10 gallons of oil per 1,000 feet B. M. for the plank and from 12 to 15 gallons for the blocks. The tank is 4 feet x 6 feet x 25 feet. They use a 15 H. P. boiler, the oil being heated to 220° F.

Flooring of this kind is particularly adapted for shops, freight and round houses, and a good deal of this kind of flooring has been laid by the Southern Pacific Ry., Oregon R. R. & Nav. Co., and other railroads in the far northwest.

The first experimental plant erected in 1906 by the Forest Service, coöperating with the Phila. & Reading Coal and Iron Co., who now being convinced of the value of the treatment have erected a complete plant similar to that of the D., L. & W. R. R. at the Auchincloss Mines.

This treating plant near Nanticoke, Pa., has just been placed in commission. The cost of this plant to the company, including all piping, tracks, engines, etc., was about $5,000. The storage tank has a capacity of 21,000 gallons, and the receiving tank, of which the cover is shown on the left of the picture, has a

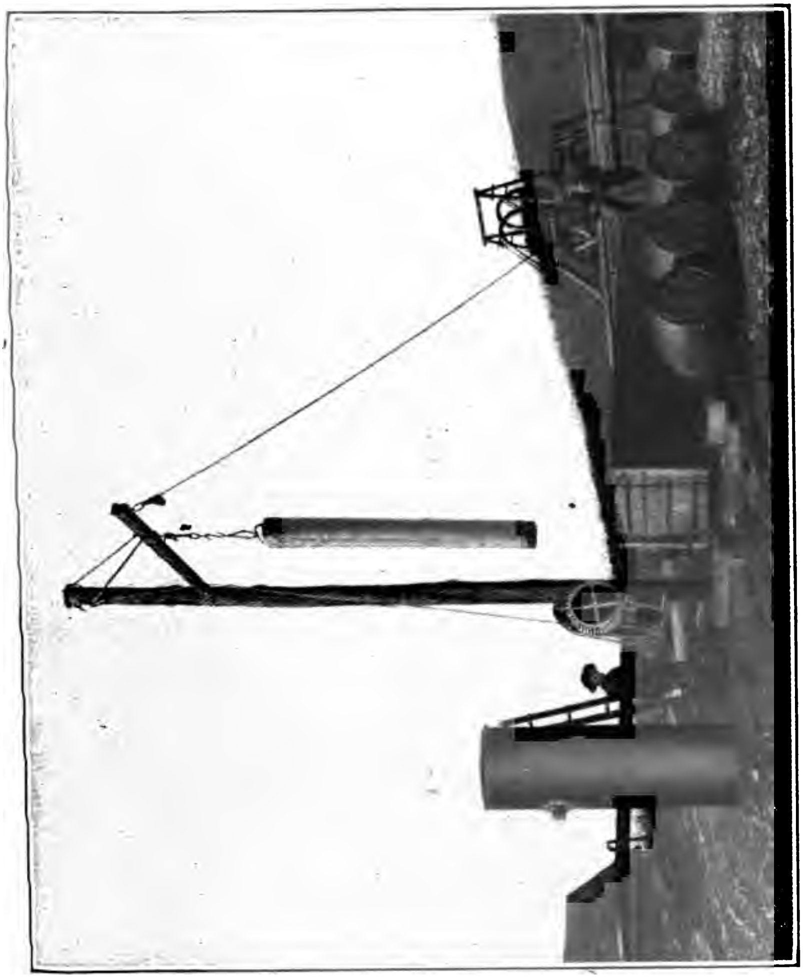


FIG. 91.—Treating outfit with very simple rigging for handling timbers.

capacity of 9,000 gallons. The treating cylinder requires 3,000 gallons when the timber is in place for treating. The dome on the cylinder is to relieve the pressure when the oil is heated, and from this the volatilized oil is run into the receiving tank, the oil running from the storage tank to the treating tank and from there to the receiving tank by gravity. The daily capacity of this plant is 4,800 feet B. M.

This plant at Scranton, Pa., is also owned by the D., L. & W. R. R., and is used for the treatment of mine ties as well as mine props. The method of handling the timber is here well illustrated.

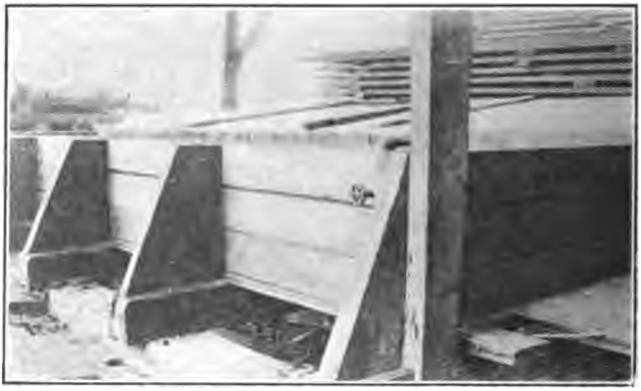


FIG. 92.—View of tank and draining platform used by the Baltimore & Ohio R. R. Co.

In this tank were treated the flooring, sills and joists for the new No. 8 Pier of the Baltimore & Ohio R. R. at Baltimore, the timber receiving a 15-minute immersion in the hot oil.

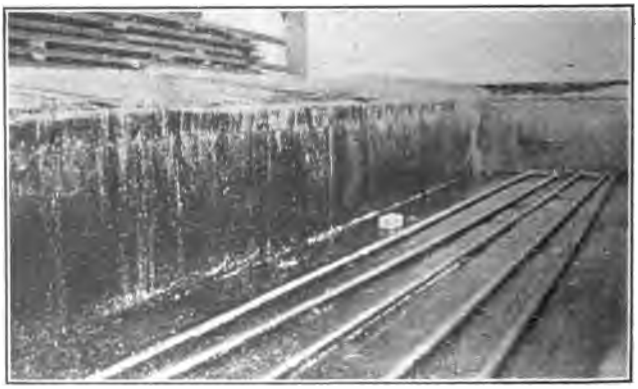


FIG. 93.—Inside view, showing arrangement of steam coils.

All the dock floors, sills and joists for the immense docks erected by the Northern Pacific Railway Company at Seattle, Wash., were treated in a manner similar to that just described.

The Minneapolis & St. Louis R. R. Co. treated bridge ties by the open tank method, using a steel tank 14 feet x 3 feet x 2½ feet deep, with steam pipes through the bottom of the tank connected with a boiler, the ties being handled with timber hooks. The total cost of treatment per 1,000 feet B. M. was $9.81, this including cost of tank and labor.

This tank is 40 feet long, 3 feet wide and 4 feet deep, with steam pipes in the bottom. In this tank the Milwaukee Car Mfg. Co. is treating car sills, etc. The crane used is worked by compressed air. The timber is treated for fifteen minutes, after which it is placed on a draining platform.

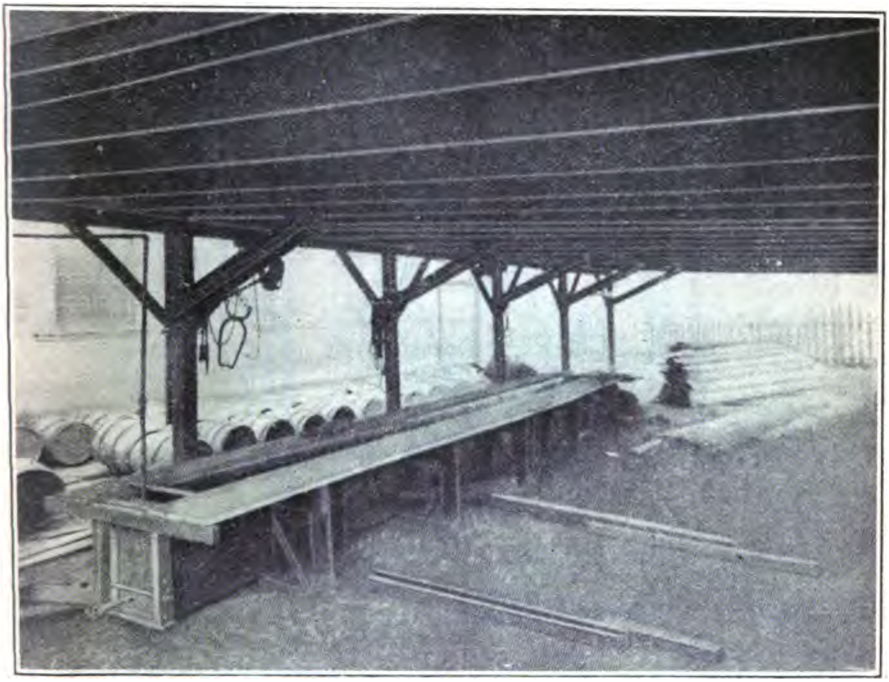
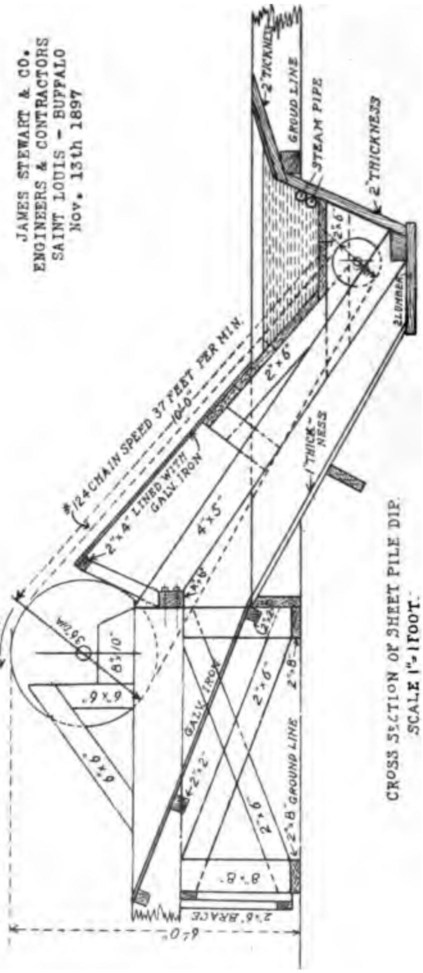


FIG. 94.—Carbolineum plant of the Ruemmeli-Dawley Mfg. Company, St. Louis, Mo.

This tank, which is built of wood, lined with galvanized iron, steam being used to heat the oil, was erected in 1900 by the Ruemmeli-Dawley Mfg. Co. at St. Louis, Mo., and has been variously used for the treatment of timbers for the city water works, as also very considerable quantities of stringers, flooring, and particularly the lumber used for the construction of water cooling towers. At this plant a charge for treatment is made of $10 per 1,000 feet B. M.

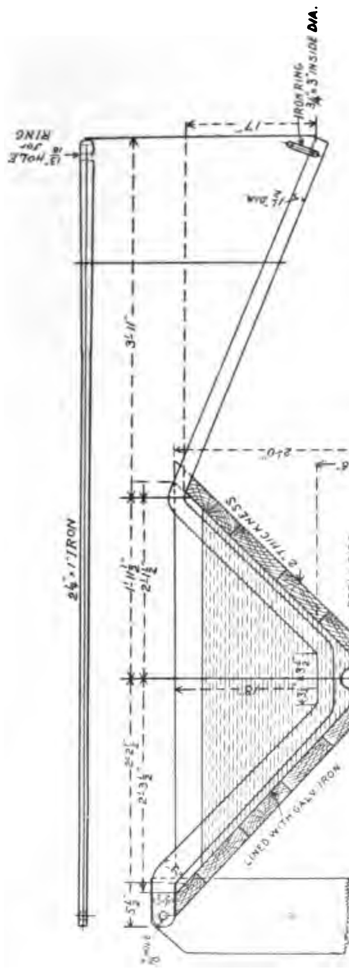


JAMES STEWART & CO.
ENGINEERS & CONTRACTORS
SAINT LOUIS - BUFFALO
Nov. 13th 1897

CROSS SECTION OF SHEET PILE DIP.
SCALE 1"=1 FOOT.

FIG. 95.—Sheet pile tank at Shreveport, La.

This as well as the treating plant for round piling shown in the next illustration were erected at Slidell, La., by James Stewart & Co., the contractors, under the supervision of the U. S. Engineer's Office of New Orleans, in 1897. Both sheath as well as round pile tanks were equipped with steam coils for heating the oil, and conveyor chains for handling the piling.



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Nov. 13th 1897

CROSS SECTION OF ROUND PILE DIP.
SCALE 1½"=1 FOOT

FIG. 96.—Round pile tank with conveyor chains, at Shreveport, La.

As bearing directly on the relative value of the open tank method, compared with that of the pressure process, the U. S. Engineers' Office at New Orleans, La., advises: "In 1897 it became necessary to rebuild the hull of the tug *Manchac*, formerly the *General Comstock*. The timber used was cypress, and under the direction of the officer in charge, the following experiment was tried: The frames were worked out to the required size and shape. One half of them were sent to the creosoting works and treated by the ordinary closed tank process. The other half were treated with a proprietary preservative in an open tank, fitted with a steam coil, to keep the liquid hot. The results have been satisfactory up to the present time, all the frames being found in good condition when last inspected.

At Slidell, La., an open tank for treating cross-arms has been operated for many years. This tank is 36 feet long, 6 feet wide and 18 inches deep. Heart yellow pine arms were treated and absorbed on an average 10 gallons per 1,000 feet B. M.

Various U. S. army engineers have used the open tank method for considerable work, a great deal of it being done in the Mississippi River Valley and on the Pacific Coast. During the past four years a tank, 30 feet x 3 feet x 18 inches, fitted with a cover and steam pipes, has been used at St. Louis by the U. S. army engineers. The superintendent of the U. S. engineers' office at Columbus, Ga., who has treated yellow pine timbers for barges and tow boats, advises that the cost of treatment for labor is about the same as if painted with ordinary paint. He gave a treatment of 125 pounds of preservative per 1,000 feet B. M., leaving the timber in the tank for from 20 to 40 minutes, according to its size. The result of the treatment was so satisfactory that a larger plant is being built for future use.

This tank of the Millville Traction Co., Millville, N. J., was originally built for butt end pole treatment, but has only been used for ties, which are allowed to remain in the liquid about twenty-four hours. Old ties are used as fuel for the boiler.

This treating outfit of the Denver City Tramway Co. is 15 feet long, 7 feet wide and 2½ feet deep, made of 3-16 inch boiler plate, the draining table being 16 feet long, with sufficient elevation to drain back into the tank. The oil is heated by keeping a slow fire under the tank. 10½ gallons of oil are used per 1,000 feet B. M. when the ties are thoroughly seasoned. At this plant 5,200,000 feet B. M. of yellow pine have been treated since 1904, at a cost of from 16 to 18 cents per tie. The charge per 1,000 feet B. M., including all labor of tearing down tie pile, treating and repiling, is $6.63. The labor is all hand work, a small crane being used to assist in piling the ties. Mr. Evans, the chief engineer, who furnished this information, estimates ten years additional life of the ties. Oregon poles are treated by the brush method 12 inches above and 12 inches below the ground line.

The Utah Light & Railway Co. of Salt Lake City, who have used approximately 150,000 Oregon fir ties treated by this method during the past seven years, estimate the cost of treatment to be about 28 cents each, or $8.68 per 1,000 feet B. M., and the resulting life of a treated tie being estimated by Mr. J. S. Wells, their general manager, as fifteen years, the ties showing no deterioration after having been in the track for seven years.

At Portland, Oregon, a company has been operating open tanks for the past seven years. They now have five treating plants in operation, one near Seattle, Wash., which is supplying the Stone & Webster properties in that vicinity. The standard form of treatment given Oregon fir is 100 pounds per 1,000 feet B. M., equivalent to about 12 gallons. A charge of $10 per 1,000 feet

B. M. is made for the treatment. Ties have been treated in considerable quantities for various street railway and railroad properties on the Pacific Coast. This I believe is the first wood preserving company employing open tanks for the treatment of ties, timber and paving blocks.

Taking as a basis the exact cost figures given by engineers operating open tanks, the average cost of treatment per 1,000 feet B. M. was $8.33,7, thus proving conclusively that the simplicity of the open tank method has considerable bearing on the cost of the treatment.

These installations are cited to demonstrate the feasibility as well as practicability of this method of treatment for companies, both large and small.

In concluding, I trust that in presenting this paper I have brought out some points that will cause a more thorough study of the subject as well as a discussion by those already familiar with the method described.

NOTE.—This lecture was illustrated with stereopticon views, a portion only of which are shown in this report.

PRESERVATION OF TIMBER.

(Standing Subject No. 5.)

REPORT OF COMMITTEES.

To the Association of Railway Superintendents of Bridges and Buildings:

This subject has been before your Association for some years. The reports to the 14th and 15th Conventions contain valuable information on the question.

The subject of preservation of timber has been under consideration for ages. There are indications that efforts were made during ancient times to prolong the life of timber used in structural work by the use of antiseptics, but as far as is known no satisfactory results were obtained until the decades between 1830 and 1850. During those years many processes came into use, but, although somewhat effective, most of them have been abandoned.

Before going into details in regard to the various processes now in use for treating timber, it may be well to give a general outline and view of the necessity or desirability for treating timber. It should be understood that for the purpose of this report, timbers used for structural work, and more particularly only structures which come under the supervision or observation of the members of this Association are supposed to be dealt with.

The question of preservation of timber to prolong its life may be one of necessity or economy, depending upon the available supply of timber, the location and kind of the structure, the cost of reconstruction, the length of life of structures on land or in sea water, etc.

This question of necessity or economy for preserving timber engaged the European engineers in the early period of railroad construction by reason of the limited area of timber lands, the density of the population requiring the land for agricultural purposes, and the advanced development of the industries of their country in those days. In the United States, to within a few decades, there was a large area of forest lands available, and what was then considered an unlimited supply of timber for all time to come.

The unsurpassed development experienced during the last half century in this country, and especially during the last twenty-five years, not only in railroad construction but in all other industries alike, has depleted the available supply of suitable timber for construction purposes to such an extent, that, if the present unrestricted and in many cases wanton destruction of our forest lands is not curbed or regulated and new forests planted, cultivated and raised, it will not be many years before this nation will be face to face with a timber famine, the effects of which cannot be estimated.

The United States government, through its Department of Agriculture, Forestry Division, is giving this matter of prolonging the supply of timber in this country a great deal of attention, in many directions. Its reports are most instructive and interesting; they are available to every one who desires them, upon application to the United States Forestry Division, Washington, D. C.

These reports contain information as to the growth and value of the various kinds of timber for various purposes, the comparative strength of timber grown in different localities and altitudes, the strength of timber in different stages of dryness, the value of live timber as compared with dead timber, and a vast amount of other interesting and valuable information regarding the subject and use of timber. By means of these publications it is hoped that the public will be taught to realize the value of, and make the best use of the timber cut, and thereby practise the first and very important lesson in conserving the available timber supply, by using it judiciously.

The Forestry Division, on account of the fast diminution of the supply of timber, has also given a great deal of attention to the subject of preservation of timber for various purposes, with antiseptics, and, while these investigations are still in progress, sufficient results have been reached to show the value of various methods and treating processes. The important point in these investigations is to find a method of treatment that combines permanency with reasonable first cost, and ease of application.

The constant reduction of the available supply of timber necessarily produces a corresponding increase in its market value. It is only by enforcing a more conservative method in the use of our forests and the lumber cut therefrom, and by treating the timber to prolong its life in the structures, that we can expect to be in a position to procure a supply of timber for our future structures.

It is true, the optimist will say, that other products will be employed for our structures as the cost of timber increases; this may be true to some extent, but for some structures or purposes timber will likely always be the most suitable material. The constant increase in the price of timber should, through economic reasons, enforce the adoption of some preservative treatment. This stage has no doubt been reached for many districts or kinds of structures in this country; so much so, that were a preservative process of known value employed, and the cost properly analyzed, the final economy for using a preservative process would be established beyond a doubt. But the first cost of the timber, plus the cost of treating it, will always be greater than the cost of timber untreated. For that reason principally a comparatively small amount of treated timber is used in our structures. For certain kinds of structures, when the cost of frequent reconstructions, the loss on account of interruptions to business during reconstruction, and the progressive increase in the first cost of timber, are properly analyzed and capitalized for both untreated and treated timber, the use of treated timber will no doubt prove the most economical.

The various States of the Union are also taking an active part in conserving the supply of timber by reclaiming waste lands and planting forest timber. But, while it takes only a short time to fell the stately tree, it takes years to grow one. If those who are

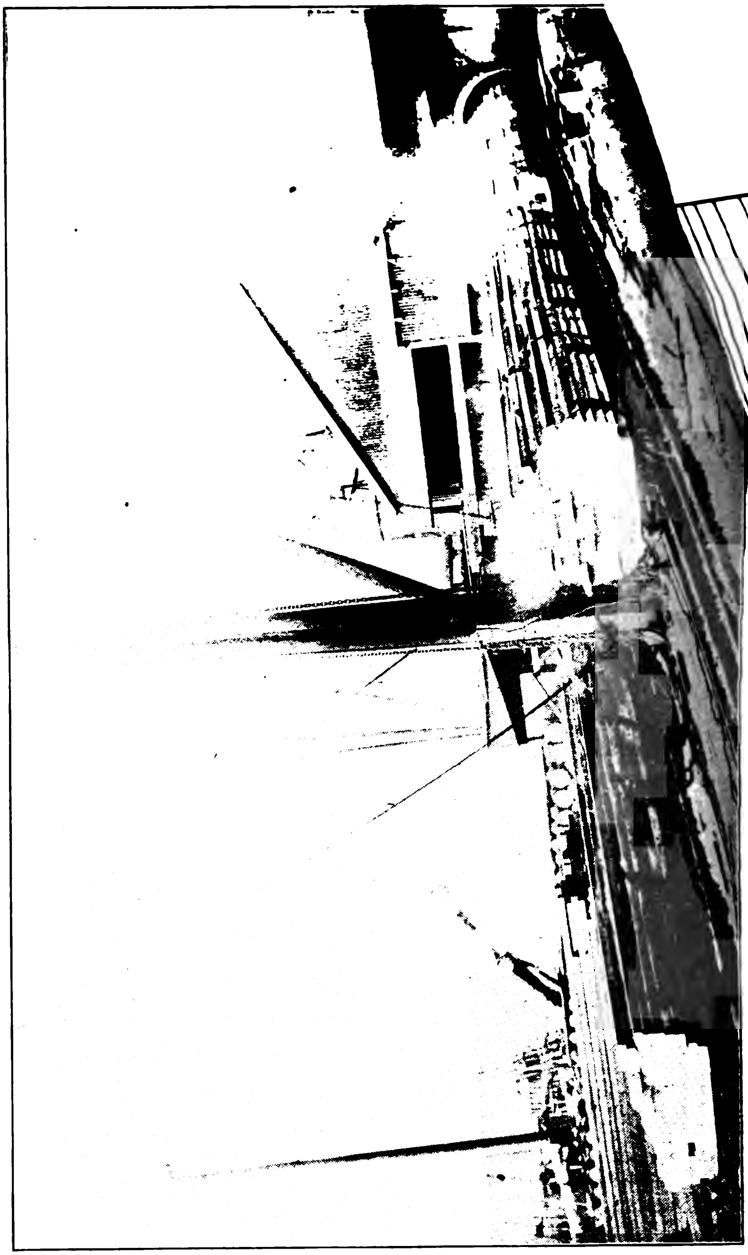
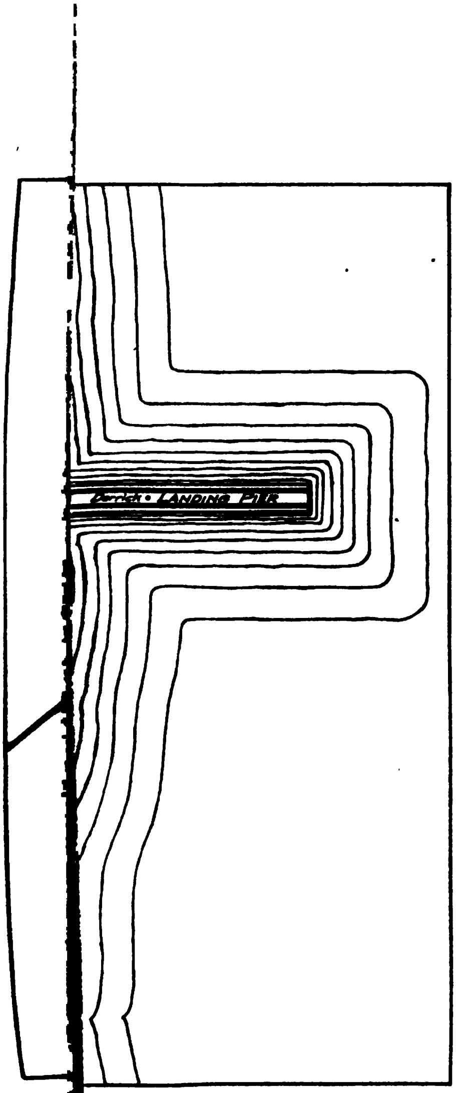


FIG. 97.--Creosoting Plant of Eppinger & Russe



Derrick • LANDING PIER

engaged in the lumbering operations could thoroughly realize this point, many a tree might be permitted to grow to maturity and be a blessing to future generations.

The various engineering societies and associations have also given the subject of preservation of timber much attention in the past, and their reports are most valuable and instructive on the subject.

The railroads of the country are large users of timber, and, considering their facilities for investigation as to the economic value of treated timber as compared with untreated timber, should use treated timber more frequently. This would be a considerable step toward reducing the draft on the timber lands to a more satisfactory amount as compared with the available supply. But on account of the first cost of treated timber over that of untreated, the latter will be used oftener, unless the national government and the various states regulate by laws the use of the forests of the country, and prohibit the present destructive methods of cutting timber. Such government or state regulation would restrict the amount of timber to be cut in a season, thereby limiting the available supply for such period, compelling consumers to adopt a preservative process that would prolong the life of timber.

Numerous processes have been patented in this country and abroad for treating timber to prolong its life, but few only have stood the test of time. The following are the processes that have gained more or less prominence at various times:

Kyanizing, using chloride of mercury.
Margaryizing or Boucherizing, using sulphate of copper.
Creosoting, using dead oil of coal tar.
Burnettizing, using chloride of zinc.
Allardyce, using chloride of zinc with dead oil of coal tar.
Wellhouse, using chloride of zinc with glue and tannin.
Thilmany, using copper sulphate and zinc sulphate, with after treatment of Barium Chloride.
Hasselmann, using sulphate of copper, iron and aluminum.
Creo-Resinate, using creosote, resin, formaldehyde, followed by milk of lime.
Hagen method, using chloride of zinc and gypsum.
Powell Process, using saccharine.
Vulcanizing.
Woodiline and Carbolineum Avenarius.

These processes have been fully described in the 1904 report of your Association, with the exception of the Powell Process; a description of this process will be given below; and the processes which are now in general use in the United States as far as they have come to the knowledge of your committee, will also be further dwelt upon in this report.

The Powell Process of treating timber with saccharine has, during the year of 1907, been extensively tested in England. This process differs entirely from other processes, both in the material employed for displacing the sap and in its method of application. The preservative agent is sugar in one or another of its varieties, molasses being used for cheap timber that requires no surface finish, and saccharine for the more expensive woods.

The timber may be treated in a closed cylinder or in an open tank. The essential part of the method consists in boiling the wood in a solution of sugar and water, after which it is artificially dried and is then ready for use.

The claim is made that on account of the boiling point of sugar being higher than that of water, the moisture contained in the wood is converted into steam and escapes in the same manner as the released air. The moisture and air having been completely driven out, the solution is permitted to cool, during which stage it is constantly absorbed by the wood. In this way the cells and interstices are filled with sugar; and, when the wood is dried, the sugar is found to be thoroughly assimilated by its tissues. Whether timber treated in this manner will give satisfactory results under all conditions your committee has not been able to ascertain. This description of the process is given only as general information.

The processes in use in the United States for treating timber are the Bethell Process or Creosoting, using dead oil of coal tar, and Burnettizing, using chloride of zinc; the former is used for all kinds of structural timber, while the latter is more generally used for treating bridge and track ties.

The process of treating timber with Woodiline or Carbolineum Avenarius, applied either with brushes or by soaking, is also used in this country. These liquids contain creosote as the preservative ingredient.

Woodiline or Carbolineum should preferably be applied to seasoned timber. Applied to green timber they will close the pores on the face of the timber, and for this reason will act rather as a detriment to the life of timber than a preservative. This treatment will no doubt give good results on smaller sticks of timber that can be air-seasoned quickly, and on which the solution will penetrate proportionately deep. For heavy railroad structures, however, the pressure processes are no doubt the most reliable and effective. Brush treatment of joints and points where water can collect will undoubtedly be of considerable benefit and will retard decay.

The Burnettizing process consists in impregnating timber with a solution of zinc chloride in water. It is used extensively by some of the western and southwestern railroads of this country for treating ties, and is apparently giving good satisfaction in localities not subject to much rainfall. The ties and truck on which they are loaded are hauled into a steel cylinder 6 to 8 feet in diameter, and from 60 to 150 feet long. When the cylinder is filled with material for treatment, the end door of the cylinder is closed and thoroughly packed and bolted, when live steam is admitted into the cylinder and held under pressure for several hours, the length of time depending on the degree of the seasoning of the timber to be treated. After the steaming has continued for such period as is necessary to liquify the sap and solidify the albumen, and transform the water contained in the timber into steam, the cylinder is exhausted of steam and air, and a partial vacuum is maintained for a short time. During this interval the moisture and liquids formed by the steam are expelled from the timber. The cylinder is then filled with the solution of zinc

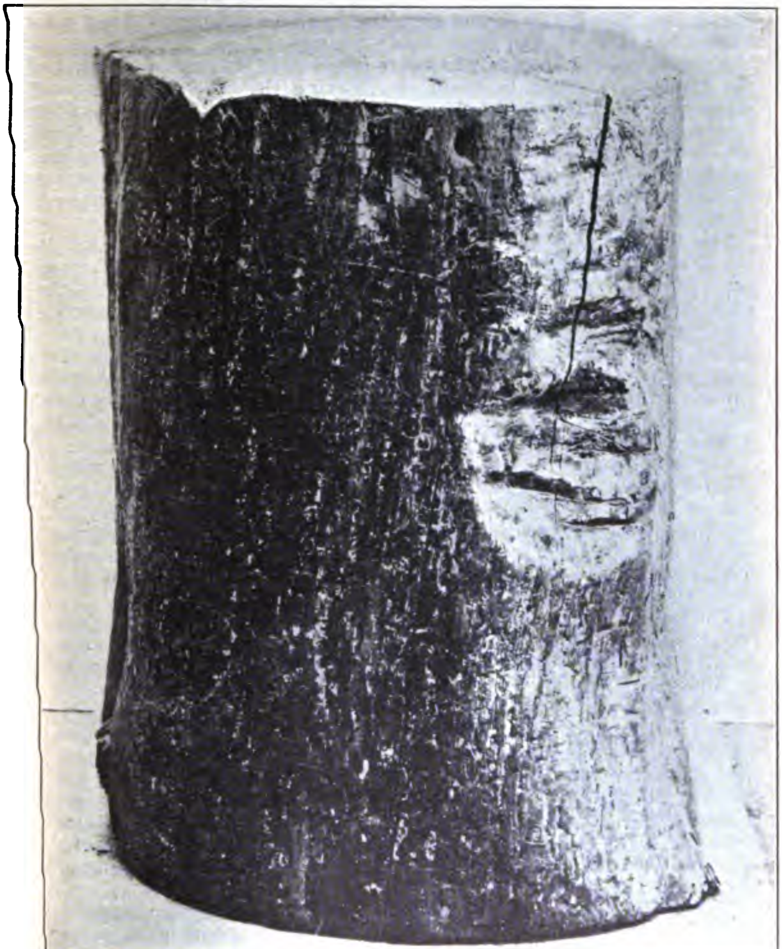


Fig. 99.— Virginia Yellow Pine, treated with Dead Oil of Coal Tar. Service 14 years in Newark Bay, N. J.

chloride and water, the pressure pumps are started, and the pressure in the tank is raised to from 80 to 100 lbs. per square inch. This pressure is maintained until the pores of the timber have absorbed the necessary amount of solution. The solution remaining in the cylinder is withdrawn, the cylinder is opened, and the timber brought out and dried ready for use.

If wood treated in this manner is exposed to the action of water the solution is likely to leach out, leaving the cells of the wood unprotected. This defect has been overcome by a light after treatment of the timber with creosote or dead oil of coal tar that has proven satisfactory. Owing to the fact that the zinc chloride solution leaches or evaporates from the timber in time, the process of Burnettizing is not desirable for treating structural timber, except for use in dry locations.

The process that has been most widely used in this country is the so-called Bethell Process, or Creosoting, using dead oil of coal tar. It is not more generally used on account of the comparatively high price of the treatment. For timber used in harbor structures, where marine insects, such as the teredo, operate, the creosoting process has been used with greatest success. Its value for such purposes is incalculable, since the teredo will not attack timber properly treated with creosote, while untreated timber is destroyed by this insect in some of our Southern ports in as short a time as six months.

Creosoted timber is also widely used for structures on land when greater permanency of structures is desired, and when reconstruction is not only expensive but the delays to such reconstruction interfere with the business to a greater or less extent. As stated before, on account of its comparatively high cost only, is creosoting with dead oil of coal tar not more universally employed for structural timber.

The Creosoting process consists in treating the timber with dead oil of coal tar. The material is treated in steel cylinders as previously described for the Burnettizing process. When the cylinder is filled with timber to be treated, live steam is turned into the cylinder and a pressure of from 50 to 70 lbs. per square inch maintained for from 3 to 10 hours, according to the condition of the timber to be treated and the amount of oil required. It is important that the artificial seasoning by steaming be done not too quickly, so as not to scorch, split or otherwise injure the timber. Timber well air-seasoned requires no steaming. At the proper time the steam pressure is removed and the condensed water in the bottom of the cylinder is blown out before the steam is exhausted through an outlet at the top of the cylinder.

When the steam is all out of the cylinder, the vacuum pump is started and kept in operation for about 4 to 8 hours at a gauge pressure from 22 to 24 inches. During this process the temperature of the cylinder is maintained by passing steam through heating coils.

When the vacuum pump is stopped, the oil, which has been heated in the storage tank to the proper temperature by means of steam coils in the tank, is admitted into the cylinder. As soon as the cylinder is full of oil, the pressure pump is started. When the gauge shows a pressure of 150 lbs., the pump is generally held at this pressure until the material to be treated has, according to the readings of the various gauges during the progress, received the quantity of oil specified. The oil not consumed is allowed to run out of the cylinder into a tank below it, and from there is pumped back into the storage tanks.

The difference in the gauges in the measuring tank before the cylinder is filled and after the unused oil is pumped back into the storage or measuring tank, shows the amount of oil that penetrated the timber. This amount can never be obtained very closely until the treatment of a batch is completed.

A modification of the general creosoting process, "The Rueping Process," is extensively used by the Atchison, Topeka & Santa Fe Ry. It includes the usual seasoning of the timber by steaming if the timber is not air-seasoned. It is then placed in a cylinder and subjected to treatment for half an hour or one hour of air pressure from 60 to 75 pounds, depending upon the wood, so that all cells will be filled with compressed air. Without reducing this pressure in the cylinders, the warm dead oil of coal tar is next forced from the storage tank into the cylinder. When the cylinder is filled with the dead oil of coal tar and the timber in the cylinder is immersed, the pressure pumps are started and the fluid forced into the wood under pressure, rising from 60 or 75 pounds to 150 or 200 pounds, depending on the nature of the wood to be treated. Under the increased pressure the oil penetrates into the cells of the wood, soaking or impregnating the cell walls, compressing still more the air formerly forced in at 60 to 75 lbs. pressure. When the wood is sufficiently impregnated with the fluid, the amount being usually specified in pounds per cubic foot, the pressure in the tank is reduced to that of the atmosphere. The air compressed in the cells forces as much of the impregnating fluid out of the wood as does not adhere to the cell walls. The excess is allowed to flow from the cylinders back into the storage tanks. This process has the distinctive feature that no more of the treating fluid remains in the wood than is necessary for impregnating, coating or saturating the cell walls.

The United States Department of Agriculture, Forestry Division, has made some tests with the open tank method of treating timber, with a view of ascertaining a cheaper and more easily applied method than the methods in general use at the present time. The Forestry Division, in its circular No. 101, claims that an open tank plant for the treatment of timber can probably be installed for less than one-fourth of the cost of a pressure cylinder plant of the type in general use. The open tank method is not to be considered as a universal substitute for the pressure process. The tests of this method have not reached the point of development, however, that would warrant its application to all kinds of timber used in structural work. It is especially well adapted to treatment of woods with coarse grain and open cells.

The experimental tests covered the treatment of fence posts, telephone poles and mine timber, and satisfactory results were obtained. No difficulty should be encountered in treating cross ties and piling of such woods as loblolly pine, black and tupelo gum, western yellow pine, and lodgepole pine. The open tank method is rapidly being developed by the United States Forestry

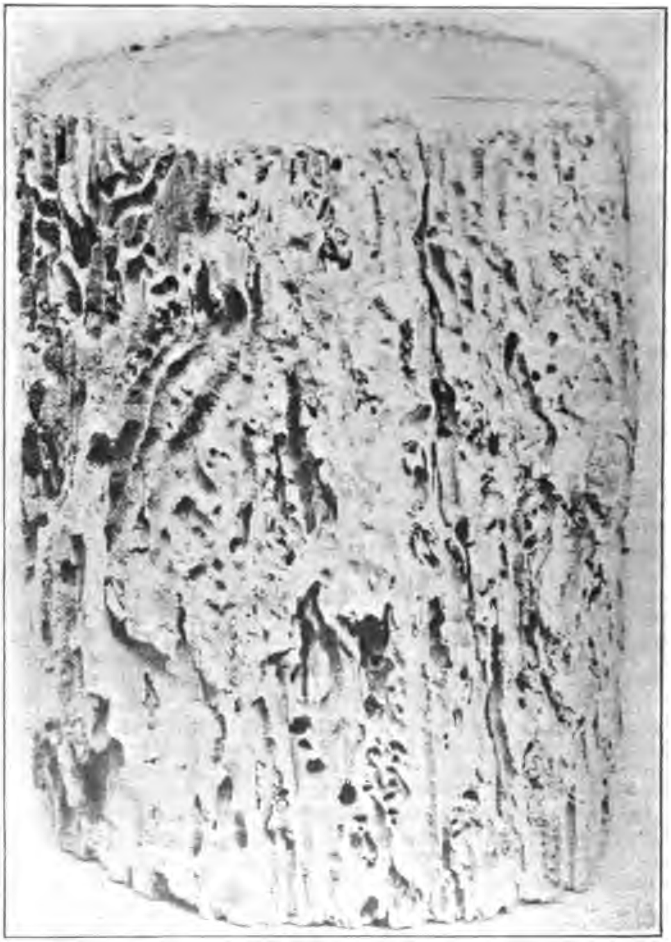


FIG. 100.--Virginia Yellow Pine, untreated. Service 14 years in Newark Bay, N. J.

Bureau, who express the hope that future experiments will reveal methods of applying it to many other species and for other purposes.

Much has been written in regard to the injury to the fiber or structure of the timber, and reduction of strength, on account of the high temperature and heavy pressure to which the timber is subjected during the treatment in pressure cylinders, but investigations made show that the percentage of injury to the timber compared with the prolongation of its life in a structure is so small that it need not be seriously considered. Much of this objectionable feature can be avoided by air-seasoning the timber before treatment and also by taking proper care during the treatment not to abuse the material, by attempting a too rapid treatment; and in all cases fitting the treatment to the kind and grade of timber under treatment.

In connection with the high cost of creosoted or other treated timber, it may be well to mention that this is in many cases due to the fact that an expensive kind and grade of timber is selected for a certain structure when a cheaper kind and grade, if properly treated, will give equal service and satisfaction. Instead of high grade Southern long leaf yellow pine, short leaf yellow pine, loblolly pine, Norway pine, and other cheaper timber may often be satisfactorily substituted.

The amount of treatment required depends largely upon the location of the structures; whether in sea water where marine insects operate; or on land, in low districts or high altitudes. The position of the timber in the structure also has a bearing on the lasting qualities. Best results are obtained when timber that is to be treated is first framed and then treated; especially if it is to be used in sea water. The least defect or injury to a treated timber near the water line in infested waters, will result in attacks by marine insects, which, having once gained an entrance, will destroy the parts not reached by the preservative. It is generally known that even with the best modern appliances the treatment will not penetrate through the whole stick of timber of the larger sizes used in railroad work.

The following shows the amount of dead oil of coal tar treatment used per cubic foot of timber on the railroads noted:

	Piles driven on land. lbs.	Piles driven in sea water. lbs.	Square Timber in Trestles and Wharves. lbs.
Southern Railway,	12	16 to 20	12
Louisville & Nashville R. R.,	12	20	12
Chicago, Rock Island & Pacific Ry.,	12	....	12
Norfolk & Western R. R.,	..	12 to 16	..
St. Louis & San Francisco R. R.,	12	....	12
Texac Pacific R. R.,	10 to 18	18 to 20	10 to 18

For use in waters infested with boring insects, less than 22 lbs. per cubic foot is not recommended.

The following quotation from a letter received by the committee from the chief engineer of the Louisville & Nashville R. R., will no doubt prove interesting for many of our members:

"The average life of creosoted timber has not been determined on the Louisville & Nashville lines. We have creosoted timber in trestles which has been in place 30 years and is still sound. We have had extensive experience with creosoted piles in sea water. It is necessary to be very careful to see that piles are properly treated for use in sea water, and they should have about 20 lbs. of creosote oil per cubic foot of timber. I have known a very long trestle constructed of fine yellow pine piles, untreated, to have been cut down by the teredo within one year after it was built. This same trestle was reconstructed with creosoted piles; the creosoted piles were driven 30 years ago and are now in use, but some of them were affected by the teredo and had to be protected by other means, surrounding them with concrete or placing vitrified clay pipe around them and filling the space between the pipe and pile with sand."

There are no doubt many other cases where treated timber has been in use for many years and is still sound. For example, the Lehigh Valley R. R. Co. rebuilt one of its coal shipping piers at Perth Amboy, N. J., in 1886, using creosoted timber and piling. The pier is still in a very good condition, and will no doubt last for many years more.

Among experts there seems to be a great deal of difference in regard to the quality of dead oil of coal tar (creosote), to yield best results for preservation of timber. Specifications as to the composition of dead oil of coal tar differ very materially, although the results desired are the same. European railroads appear to have secured better results than those obtainable in this country, due, no doubt, in a considerable degree, to the difference in the composition of the coal from which the coal tar is obtained. Specification requirements, as well as the quality of the oils, differ in their composition.

Results from creosoted timber in this country are very remarkable. It is surprising that, although the life of creosoted timber, in many instances, is three or four times greater than that of untreated timber, creosoted timber is not more universally used for all kinds of structures, not only in sea water where the marine insects operate and practically compel the use of creosoted timber, but also for structures on land where the cost of renewals, combined with the interference with operations, is an item of great expense and inconvenience.

No specific data can be furnished covering the cost of creosoted timber. This cost varies so greatly with the location, market conditions, etc., that any data given would be misleading. It may be of interest, however, to state the cost of treatment of the timber irrespective of the first cost of the timber. Even the price of the treatment varies considerably on account of the changes in the market price of the dead oil of coal tar, the cost of fuel and labor, but the figures noted below for creosoting timber may be useful as a general guide.

Cost of treatment of yellow pine square timber, 8 lbs. of oil per cubic foot, about $12.50 per M. ft. B. M.

Cost of treatment of yellow pine square timber, 12 lbs. per cubic foot, about $16.00 per M. ft. B. M.

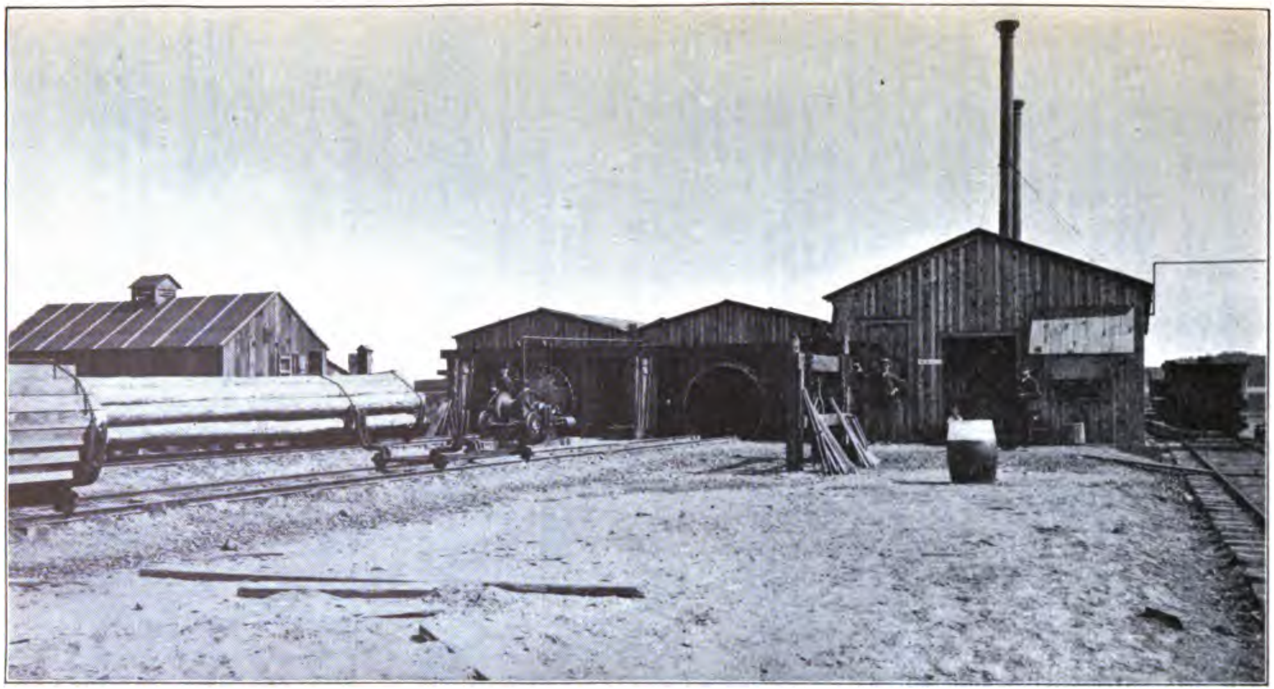


FIG. 101.--General view of small Creosoting Plant.

Cost of treatment of yellow pine square timber, 16 lbs. per cubic foot, about $20.00 per M. ft. B. M.

Cost of treatment of yellow pine piling, 12 lbs. per cubic foot, about 20 c. per cubic foot.

Cost of treatment of piling, 18 lbs. per cubic foot, about 24 c. per cubic foot.

These prices are based on the price of oil about 7½ c. per gallon delivered at the creosoting works, and the cost of labor, fuel, etc., about $4.50 per M. ft. B. M. To this must be added the interest charge on plant, depreciation of plant and profit.

In comparing prices for creosoted timber, it should be remembered that the condition of the timber to be treated, the kind of timber to be treated, and the amount of treatment required, will have a bearing on its cost f. o. b. at the works. The total cost of the treated timber will be represented by the sum of the transportation charge from the works to the site of the structure where the material is to be used, the cost of the untreated timber at the works and the cost of treatment.

For Burnettizing bridge ties, using one-quarter of a pound of pure zinc chloride per cubic foot of timber, reducing the strength of the solution to about two and one-half per cent, the cost again varies with the quality and kind of timber, but generally $1.90 per M. feet B. M. at the works for cost of treatment can be assumed as a fair figure for pine ties.

Committee. {
F. E. Schall,
F. D. Beal,
W. F. Steffens,

APPENDIX.

OUTPUT OF U. S. FORESTS IN 1906.

EXTRACT FROM CIRCULAR 129, U. S. FORESTRY SERVICE.

Total quantity of timber used annually for lumber and other products, approximates 50 billion feet board measure, represented by the following species:

Yellow pine,	31.1 per cent.
Douglas fir,	13.2 "
White pine,	12.2 "
Hemlock,	9.4 "
Oak,	7.5 "
Spruce,	4.4 "
Western pine,	3.7 "

These seven kinds of timber furnish over four-fifths of the total, and no other kind reaches one billion feet board measure annually. Under lumber is included sawed railroad cross ties.

The three kinds of lumber which are most largely exported are yellow pine, redwood and Douglas fir, the first going principally to Europe and the others most largely to Australia, the Orient and South America.

During 1906 exportations of yellow pine amounted to about 8% of the total cut, and that of Douglas fir to nearly 8% of the cut. Considering all kinds, the exports of hewed and sawed timber and lumber amounted to about 5% of the total lumber production in 1906.

The lumber cut by states in 1906 is as follows:

Washington,	11.5	per cent.
Louisiana,	7.4	“
Wisconsin,	6.2	“
Michigan,	5.6	“
Mississippi,	4.9	“
Arkansas,	4.9	“
Texas,	4.6	“
Pennsylvania,	4.3	“
New York,	2.1	“

Fifteen states of the Union which cut over one billion feet board measure lumber in 1906 supplied three-fourths of the total production.

ESTIMATED QUANTITY OF STANDING TIMBER.

The most detailed estimates range roughly from 1,400 to 2,000 billion feet board measure. Assuming the larger figure as nearest correct, and adding an annual growth of 40 billion feet, it is figured that a 33 years' supply is available on a basis of a maximum consumption of 100 billion feet annually.

The two leading kinds of timber on the market now are Southern yellow pine and Douglas fir. The cut of yellow pine is nearly one-third of the total annual cut and is nearly if not quite at its maximum.

The minimum and maximum estimates of yellow pine stumpage are 130 to 300 billion feet. The present rate of cutting will exhaust the supply in about 10 years in the first case, and in about 25 years in the second case.

The estimated stumpage of Douglas fir is 350 billion feet; this means a 70 years' supply at the present rate of cutting, neglecting annual growth. As it is possible that the cut will be more than double within a few years, the outlook is that little Douglas fir will be left in from 25 to 30 years.

THE ATCHISON, TOPEKA AND SANTA FE RAILWAY.

SPECIFICATIONS FOR CREOSOTING PACIFIC COAST PILING AND TIMBER.

PILING (WATER-SOAKED).

The piling to be treated must be Douglas fir, conforming to the Santa Fe's specifications for this class of material, the cubical contents of each stick being determined by the railway company's table of cubical contents.

Each cylinder charge must be made up of piles which have been in the water as nearly as possible the same length of time; nor must they have been so long therein as to cause deterioration or damage of any kind, but at time of treating must be thoroughly

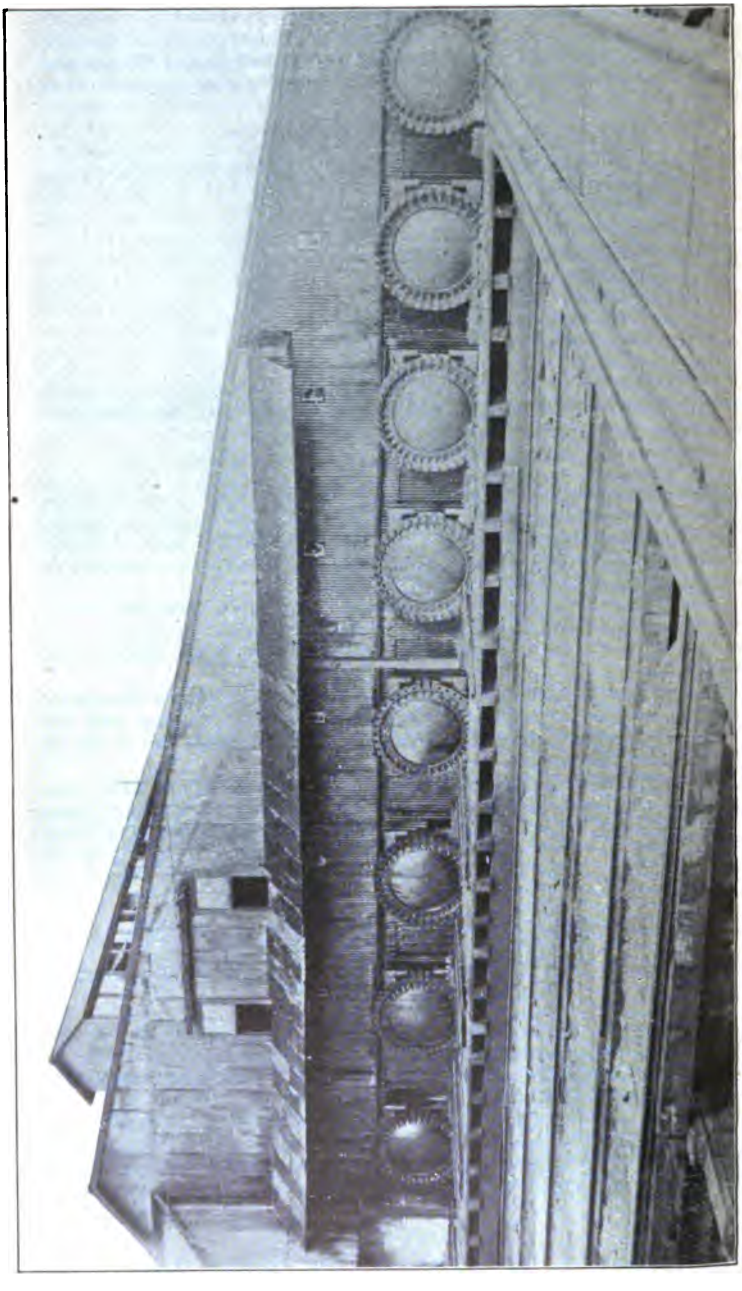


Fig. 102.—Creosoting Plant of Pacific Creosoting Co. at Eagle Harbor, Wash.

sound, free from sea worm holes and limnoria, also from barnacles and the like.

After the piles are placed in the cylinder they must be immersed in creosote oil of a temperature ranging between 160 degrees and 170 degrees F.; and kept covered during the entire boiling period under at least four inches of oil at the shallowest place. The engineer on duty must from time to time during the boiling satisfy himself by bleeding the cylinder, that such is the case.

After filling the cylinder with oil, steam must then be regulated through the heating coils so that the temperature within the cylinder is kept gradually rising as fast as the condensation will permit until 220 degrees F. is reached; after which the steam pressure must only be such as to maintain a regular and constant temperature within the cylinder with 220 degrees as the minimum and 225 degrees F. the maximum, until such time as the amount of condensation per cubic foot per hour collecting in the hot well of the condenser shows the interior of the wood to be thoroughly dry, when the steam pressure in the coils should be released, and the cylinder filled up with creosote oil from the storage or working tank, of a temperature ranging between 160 degrees and 170 degrees F., then pump pressure applied until the gauge shows 5 lbs. pressure in the cylinder (this to insure the fact of the cylinder being actually full), after which the connection between storage tank and cylinder should be closed and the connection between measuring tank and cylinder opened. Additional pressure must then be applied until the piling has taken the proper amount of oil, forced in under such conditions as will insure its complete retention in the wood after drip is over, and figured at the weight of the dry oil per gallon at 165 degrees F.; the cylinder doors may then be opened, provided the temperature within is reduced below 200 degrees F.

After treatment the piling must be free from all heat checks, water bursts, and other defects due to inferior treatment which would impair usefulness or durability for the purposes intended. Piles when bored midway between the ends must show no moisture in to the centre, and the borings beyond the oil penetration must retain their natural elasticity and strength. The penetration of black oil midway between the ends, for a 10 lb. treatment should be at least three-quarters of an inch in piles up to 40 ft. in length; 1 to 1¼ inches for piles between 40 and 70 ft. in length; and 1¼ to 1½ inches for piles 70 ft. and over, with a correspondingly greater depth for an increased quantity of oil.

GREEN OR FRESHLY CUT AND SEASONED PILING.

Green or freshly cut piles delivered at the treating plant on cars, or any which have not been lying in the water, must be treated in the manner prescribed for green or freshly sawed material.

Thoroughly seasoned piles must be treated in the manner prescribed for thoroughly seasoned sawed material.

No piling in these two classes must be mixed together and treated in the same charge.

DOUGLAS FIR SAWED MATERIAL.

Seasoned and green or freshly sawed material must not be mixed together and treated in same charge, and none should be treated which is not at the time free from rot, and in proper condition for use after treatment so far as splits or breaks are concerned; if any such is received from the mills it should not be treated unless the inspector directs it to be done.

Square timber must not be treated in the same charge with planking, nor ties with planking, and sufficient one-inch strips must be placed between each tier, with from one-half to one inch space left between each piece, so that the oil can have free access to all surfaces.

After the material is placed in the cylinder, it must be immersed in creosote oil of a temperature ranging between 160 degrees and 170 degrees F. and kept covered during the entire boiling or heating period under at least 4 inches of oil at the shallowest place; the engineer on duty must from time to time during the boiling satisfy himself by bleeding the cylinder that such is the case.

In the case of green or freshly sawed material, steam must thereafter be regulated through the heating coils so that the temperature within the cylinder is kept gradually rising as fast as the condensation will permit until 212 degrees F. is reached, with 215 degrees F. as the maximum, after which the steam pressure must only be such as to maintain a regular and constant temperature within the cylinder between these figures, until such time as the amount of condensation per cubic foot per hour collecting in the hot well of the condenser shows the interior of the wood to be thoroughly dry, when steam pressure in the coils should be released.

In the case of thoroughly seasoned material, the temperature of the oil in the cylinder must be allowed to rise slowly and steadily until 190 degrees F. is reached, with 192 degrees F. as the maximum, and kept between these figures until such time (dependent upon the dimensions) as the interior of the wood shall have become sufficiently warmed up to enable it to take the required amount of oil, when the steam pressure in the coils should be released.

The cylinder should then (in each case) be filled up with creosote oil from the storage or working tank, of a temperature ranging between 160 degrees and 170 degrees F., and pressure from the pump applied until the gauge shows 5 lbs. pressure in the cylinder (this to insure the fact of the cylinder being actually full), after which the connection between storage tank and cylinder should be closed, and the connection between measuring tank and cylinder opened. Additional pressure must then be applied slowly and steadily until the material has taken the proper amount of oil, forced in under such conditions as will insure its complete retention in the wood after drip is over, and figured at the weight of the dry oil per gallon at 165 degrees F.; the cylinder doors may then be opened, provided the temperature within is below 200 degrees F.

After treatment the material must be free from all heat checks,

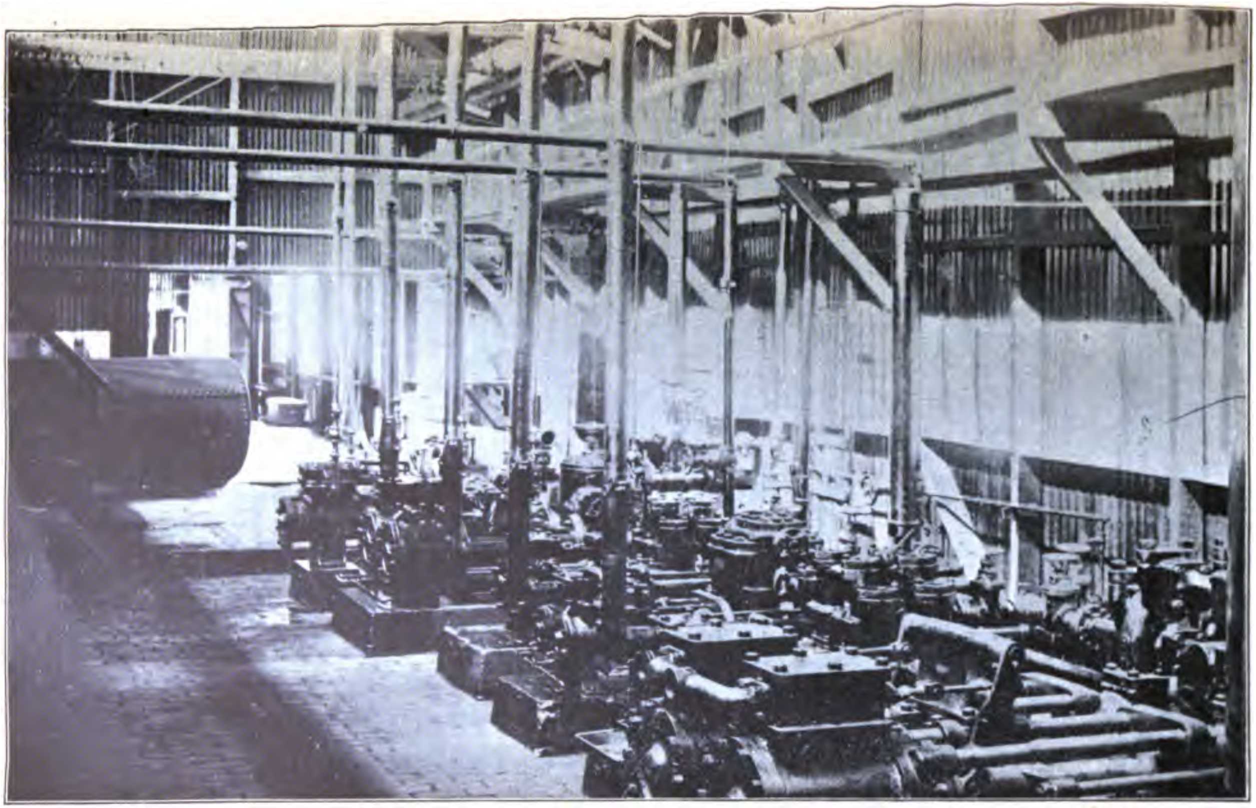


Fig. 103.-- Pump Room at Creosoting Plant of Pacific Creosoting Co. at Eagle Harbor, Wash.

water bursts and other defects due to inferior treatment, which would impair usefulness or durability for the purposes intended. The penetration of black oil midway between the ends for a 10 lb. treatment should be at least ¾ of an inch deep on dimension timber, and on planking at least ½ inch deep; with a correspondingly greater depth for an increased quantity of oil.

GENERAL CONDITIONS.

All material shall be treated to the entire satisfaction of the railway company's inspector, he being allowed full access at all times to the facilities used in the treatment while it is in progress; but the fact of an inspector being at the plant shall not relieve the treating company's officials from the responsibility of seeing that the treatment of all material is properly and carefully done, with the agreed penetration of oil in each case, based on the contract amount.

Before each cylinder charge is disposed of, the depth and character of the penetration must be ascertained by boring one or more auger holes after the wood has cooled, in as many pieces of each class of material as may be necessary for the purpose; and such pieces as are not found to be fully treated in accordance herewith must be returned to the cylinder with a subsequent charge for further treatment without extra cost therefor; should more than 10% of the total number of pieces treated be found defective, the entire charge must be so returned. No material must be removed from the treating yard until all auger holes are tightly plugged with creosoted plugs.

The intent of these specifications is that the wood, when it comes out of the cylinder and after all drip is over, shall contain the full weight of oil to the cubic foot, forced in at such pressure and under such conditions as to enable the wood cells and fiber to retain it permanently; but as there is more or less rebound of oil out of the wood after pressure is released, a checking up of the oil on hand against the total contract absorption of the various charges shall be made each twenty-four hours, timber and piling being kept separately; and if any difference is found to exist a coefficient shall be established and used until the next checking shows the necessity for a different one, provided that in case of a deficit no deduction shall be made on Santa Fe material for any excess in treatments made for other parties in previous charges which contained none of its material.

The pressure gauges and thermometers must be compared and tested at frequent intervals with standard test appliances kept on hand for that purpose, and all differences corrected.

Competent and experienced engineers shall be in charge of the treatment night and day, and required to make frequent examination of the temperatures during boiling, especially when the maximum heat is being applied; the thermometers being located so that they will correctly reflect heat conditions within the cylinders, and at the same time be convenient to get at.

In handling material after treatment, sharp dog or cant hooks must not be used in any way whereby the full protection of the treatment is likely to be lessened; where it may be necessary, as in the case of piling, they must be used in the space within two feet from the large end and six feet from the point. Any material broken or otherwise damaged in treatment or by careless handling while in the treating company's care and until delivered to the railway company at destination as per contract, will be rejected and the treating company must submit new pieces therefor; or if the material is furnished by the railway company, the cost will be charged to the treating company.

The oil must be a pure dead oil of coal tar without adulteration, with a specific gravity of 1.04 to 1.10 at a temperature of 60 degrees F.; it must be perfectly liquid at 100 degrees F. and remain so on cooling down to 90 degrees F. The distillation must be conducted under the Von Schrenk or American method as published in Bulletin No. 65 of the American Railway Engineering and Maintenance of Way Association, and of the dry oil, the boiling points shall be: Up to 210 degrees C. not more than 5%, and between 210 degrees C. and 235 degrees C. not more than 30% shall distill over, while at 355 degrees C. at least 90% shall distill over. As a different method of distillation is used abroad, sufficient allowance must be made in these percentages in case the oil is imported, so as to bring it within the specified limits when analyzed by the above method.

Before the first treatment begins, the treating company must furnish a gallon sample of the oil proposed to be used hereunder, same to be sent to the railway company's chemist at Somerville, Texas, for analysis; and in case a different oil is thereafter used, a new sample must be sent as above for further examination.

In case no inspector is on hand, the treating company must fill up the Santa Fe inspection report blank No. 959—A and send it promptly after completion of each charge to E. O. Faulkner, Manager, Tie and Timber Department, Topeka, Kansas; also the usual material report to W. E. Hodges, General Purchasing Agent, Chicago, Illinois.

E. O. FAULKNER,
Manager, Tie and Timber Department.

Topeka, Kansas, May 1, 1907.

GENERAL SPECIFICATIONS FOR CREOSOTED LUMBER AND PILING.

IN USE ON THE LOUISVILLE & NASHVILLE RAILROAD AND THE WEST PASCAGOULA CREOSOTING WORKS.

(These works are owned and operated by the Louisville & Nashville R. R. Co.)

LUMBER.

All lumber must be yellow pine, and must measure full dimensions. It shall be square edge, free from large, loose or unsound knots, through shakes, or any other defects impairing its strength, all of which is covered by the trade term "Square Edge and Sound."

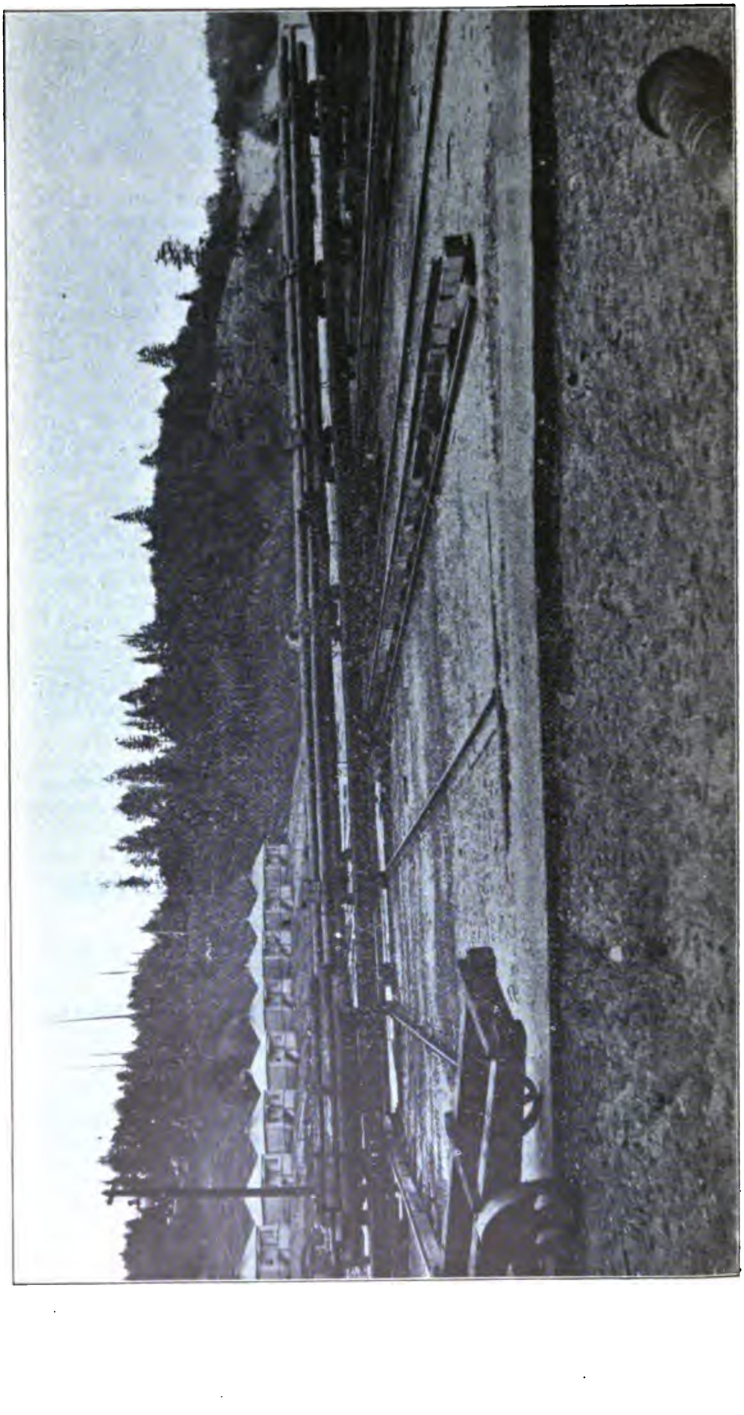


FIG. 104.--Treated Piling on Transfer Table, Pacific Creosoting Co., Eagle Harbor, Wash.

The more sap there is in timber the longer it will last, when creosoted, as the sap wood will receive the creosote oil more readily and hold a larger quantity of it.

PILING.

Piling must be yellow pine, straight, sound, free from large knots, and with bark removed, and shall measure full size and length.

CREOSOTE OIL.

The oil used in treating lumber or piling must be the best obtainable dead oil of coal tar, with a specific gravity of not less than 1.025 at a temperature of 95 degrees Fahrenheit (35 degrees Centigrade). It must not yield more than 20 per cent of its weight by distillation up to 410 degrees Fahrenheit (210 degrees C.). Between 410 degrees F. and 455 degrees F. (235 degrees C.) there shall distill off at least 40 per cent of the oil by weight. At least 25 per cent shall be what is known as heavy oil, that does not distill until 500 degrees F. has been reached.

Water to the extent of 2.5 per cent shall be allowed in oil without compensation. Any amount of water over 2.5 per cent and up to 8 per cent shall be compensated for by the injection of a proportionately larger amount of oil into the timber. No oil with more than 8 per cent water shall be used.

Note.—The distillate between 410 degrees F. and 455 degrees F. is nearly all naphthaline, and there is two or three per cent of naphthaline distilled just before 410 degrees F. is reached and just after 455 degrees F. is passed. This analysis will insure more than 40 per cent of naphthaline.

The seasoning shall be accomplished by the direct application of live steam admitted into the treated cylinders. The steam-guage pressure in the cylinders shall be regulated according to the following schedule:

For material with minimum dimension from 1 inch to 4 inches, 30 lbs.

For material with minimum dimension from 5 inches to 8 inches, 35 lbs.

For material with minimum dimension above 8 inches, 40 lbs.

Piles with not less than 7" points, 40 lbs.

During the process of steaming the cylinder must be frequently drained by a valve located at the lowest possible point. The steaming must continue from ten to fifteen hours, according to size of material and quantity of oil to be injected.

SEASONING (VACUUM).

At the end of the steaming period a vacuum shall be created in the cylinders, the temperature at all times being maintained above the boiling point. The vacuum must continue until the gauge shows a reading of from 22 to 26 inches, and be kept at that reading for about six hours, or until no moisture comes from the bottom of the cylinders.

INSPECTION OF OIL.

After the material has been thoroughly seasoned, and it has been ascertained that no sap or moisture remains in the cylinder, creosote oil shall be admitted at a temperature of not less than 120 degrees F. (49 degrees C.), which shall be raised to not less than 180 degrees F. (82 degrees C.), and put under pressure of 125 pounds per square inch. The force pump producing this pressure shall be kept in operation until the established system of measurement shows the wood to have absorbed the desired quantity of oil. The pressure shall then be released, and the material, now completely treated, will be ready for removal.

PACIFIC CREOSOTING COMPANY.

DESCRIPTION OF THE CREOSOTING PROCESS USED BY THIS COMPANY.

(Furnished by Mr. F. D. Beal, Superintendent.)

The green timber is loaded onto the tram cars and run into the retort. The door is now closed and bolted fast, making it hermetically sealed. Enough creosote is now run into the retort to completely cover the load and the temperature is gradually raised, by passing steam through the heating coils, until it reaches 215 or 225 degrees F. (This temperature depending upon the condition of the wood before it goes into the retort.) This temperature is now maintained until the moisture in the wood is thoroughly driven off. To accomplish this with any degree of certainty the vent from the retort is opened to a condenser, and the rate at which the vapors coming over are condensed is carefully noted by means of a guage glass. When the rate finally comes down to 1½" per hour, or, what amounts to the same thing in this case, when it condenses at the rate of .0629 pounds per cubic foot per hour, it is known that the wood is practically dry. This step in the process usually requires about 48 hours for piling, 25 hours for sawed timber, and 5 or 6 hours for paving blocks. So far this has been found to be a very satisfactory method of seasoning as it can be accomplished with a comparatively low degree of heat (215–225 degrees F.), and it leaves the sap wood quite free from checks and the heart wood dry. The fiber of the wood is not in the least impaired in this seasoning step, as is often the case in the steaming-vacuum process.

As soon as the wood has been dried out, the retort is filled completely full of creosote, all openings closed, and a pre-determined amount is forced into the wood. The quantity of oil injected in this way depends upon the treatment the wood is to receive and is reckoned in number of inches from the measuring tank. The pressure required to force this amount into the wood depends on the treatment, the structure of the wood and the nature of the timber. For example: Here, where Red Douglas fir is treated exclusively, the pressure usually reaches about 110 lbs. for piling, 150 lbs. for sawed timber, and 50 or 60 lbs. for paving blocks. The length of time for this pressure period is quite short compared with the rest of the process, it requiring

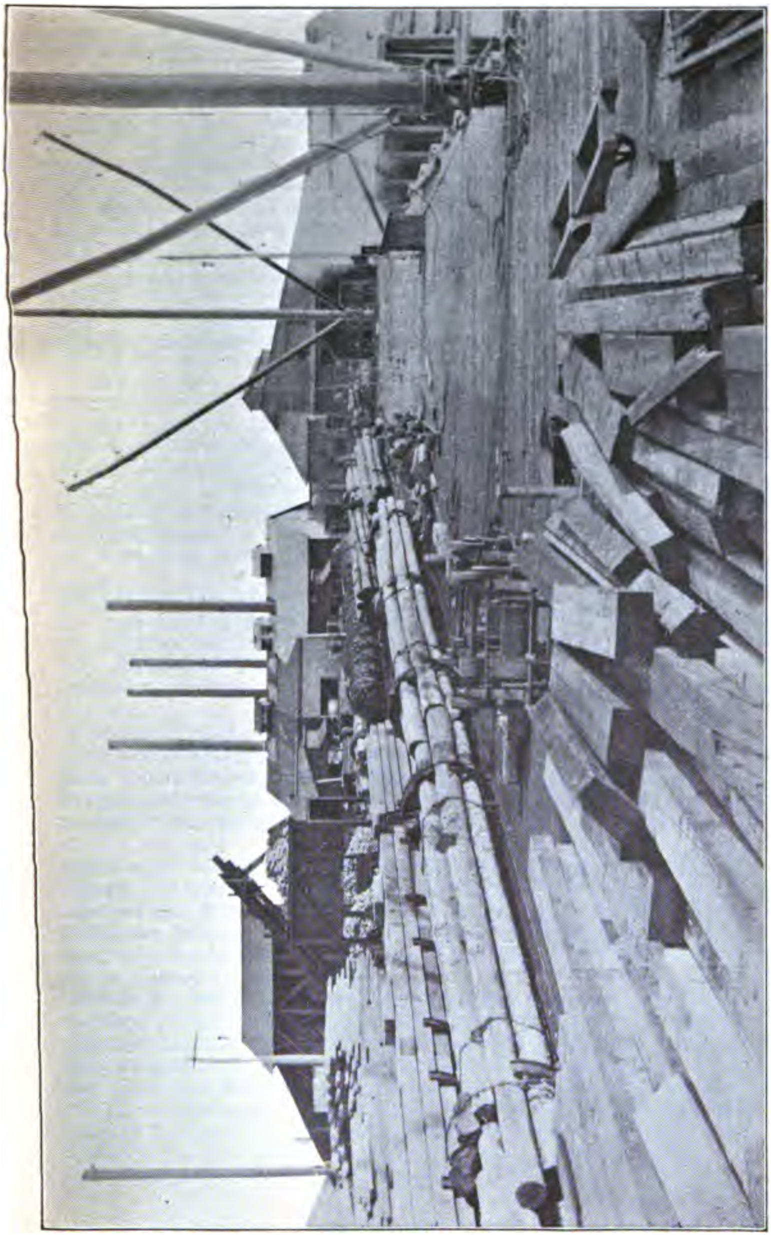


FIG. 105.—View of Loading Dock, Pacific Creosoting Co., Eagle Harbor, Wash.

about a half hour for a 12-lb. treatment of piling, and an hour and a half for a 12-lb. treatment of sawed timber. This variation in time is due to the difference in ease with which the oil penetrates the sap and heart wood.

Finally the oil is blown out of the retorts, the charge drawn out and unloaded, leaving the cylinder ready for another load.

The treatment the wood is to receive depends on the uses it is to be put to. The common practice here on the Pacific coast, where Red Douglas fir is used exclusively, is to give timber used in marine work 12 lbs. of oil per cubic foot, and where merely protection against rot is desired 10 lbs. per cubic foot is recommended. Paving blocks receive from 12 to 16 lbs. per cubic foot.

For general use this method of treatment for preservation has been found to be very efficient. Careful inspection of the timber treated in this way has shown it to be thoroughly seasoned, quite free from checks, the sap and heart wood practically dry and sterilized, while, at the same time, the fiber of the wood retains its original strength and elasticity.

Concerning the Burnettizing Process:

At the present time the Pacific Creosoting Company is doing nothing with this process as there is practically no call for material treated in this manner in the Pacific Northwest. The main reason for this being due to the fact that the annual rainfall is so great that the soluble zinc chloride coming in contact with so much moisture soon leaches out, leaving the wood subjected to the elements.

The Harriman lines are about the only people on the Pacific coast that have Burnettizing plants in operation, a large part of their territory being in high arid regions where the rainfall is very light. For this reason they are insured of a longer life for the railway ties, as this is practically the only material adapted to the zinc chloride process.

It has been recommended that some supplementary treatment be applied with the Burnettizing process to prevent the leaching out of the salts, but where this has been tried the additional cost incurred has been such that it is not warranted by the proportional increase in life. Hence this method cannot be called a success.

The tendency of all consumers of treated material is to look upon the Creosoting process as the best means of preserving wood, and it is altogether probable that in a very few years this process will be the only one used, as the long life of treated material is desired. Although the first cost is greater, the ultimate saving results in economy.

In all well regulated and up-to-date plants an inspector should be employed whose duty is to inspect the treated timber, making note of the condition of the wood and depth of penetration. He also should keep a record of the time taken for each step in the process of treating, the temperature and pressure for each on suitable blanks or in a book provided for that purpose.

Eagle Harbor, Washington, May 1, 1908.

STANDARD SPECIFICATIONS FOR COAL TAR CREOSOTE.

RECOMMENDED BY DR. HERMANN VON SCHRENK, E. B. FULKS AND A. L. KAMMERER, COMMITTEE OF AMERICAN RAILWAY ENGINEERING AND MAINTENANCE OF WAY ASSOCIATION.

Bulletin No. 93. November, 1907.

The oil used shall be the best obtainable grade of coal tar creosote; that is, it must be a pure product of coal tar distillation and must be free from admixture of oils, other tars or substances foreign to pure coal tar; it must be completely liquid at thirty-eight (38) degrees Centigrade, and must be free from suspended matter; the specific gravity of the oil at thirty-eight degrees Centigrade must be at least 1.03. When distilled according to the standard method, that is, using an eight (8) ounce retort, asbestos covered, with standard thermometer, bulb one-half inch above the surface of the oil, the creosote, calculated on the basis of the dry oil, shall give no distillate below two hundred (200) degrees Centigrade, not more than five (5) per cent below two hundred and ten (210) degrees Centigrade, not more than twenty-five (25) per cent below two hundred and thirty-five (235) degrees Centigrade, and the residue above three hundred and fifty-five (355) degrees Centigrade, if it exceeds five (5) per cent in quantity, must be soft. The oil shall not contain more than three (3) per cent water.

METHOD OF ANALYZING CREOSOTE OIL USED BY THE PACIFIC CREOSOTING COMPANY.

(Furnished by Mr. F. D. Beal, Superintendent.)

The Standard American or Von Schrenk method as outlined in Bulletin No. 65 of the American Railway Engineering & Maintenance of Way Association.

This method is to weigh 100 grains of oil into a tarred 8 oz. glass retort. Connect outlet tube with a length of glass tubing so that the discharge is at least 20 inches from bulb. Insert thermometer into the retort so that the bulb is ½ inch above the level of the oil, and let the thermometer remain undisturbed during distillation. Place retort on an asbestos mat which has a small circular opening allowing only the bottom of the retort to come into contact with the flame. Protect retort with an asbestos hood from any draught of air that might affect retort and thermometer. Gently heat the oil and regulate flame so distillation will be completed in about 35 minutes.

Ordinarily only three distilling fractions are caught 00 degrees C. to 210 degrees C., 210 degrees C. to 235 degrees C., and 235 degrees C. to 355 degrees C. The fractions are caught in beakers and weighed. The difference between the weights and the original weight of the beakers equals the weight of the fractions.

The residue or oil remaining in the retort above 355 degrees C. usually has the consistency of soft pitch.

Beside the distillation we determine the percentage of tar acids and of naphthaline by pouring the three fractions into a warmed separatory funnel with 40 c. c. of 15% solution of sodium hydroxide. After repeated shaking of the funnel the sodium hydroxide is allowed to settle, and is drawn off into another separatory funnel, which has been previously weighed. Wash the distillate again with sodium hydroxide, and to make sure that all tar acids have been removed, add this sodium hydroxide to first portion and neutralize with dilute sulphuric acid. Allow funnel to stand until tar acids have collected on top, and then draw off the colorless sodium sulphate solution. Weigh the separatory funnel and difference in weights gives the amount of tar acids present.

Pour into a beaker that portion of the distillates insoluble in sodium hydroxide and set in a cool place until all naphthaline has crystallized out. Collect the crystals and squeeze out the oil with heavy pressure and weigh the resulting oil-free naphthaline.

Beside the above quantitative test we apply a qualitative test to determine the purity of the oil. This test consists in determining the solubility of creosote in absolute alcohol and benzol. If there is an insoluble residue, which indicates adulteration, we apply the sulphonation test to determine the amount.

This test is described in a recent bulletin, "The Analysis and Grading of Creosote," issued by the Department of Agriculture, Forest Service, Circular No. 112.

ACKNOWLEDGMENTS.

The committee desires to express its thanks for the valuable information received from various railroad engineers, superintendents and managers of creosoting companies, and also for information obtained from the reports of the United States Forestry Division, the Reports of the American Society of Civil Engineers, the American Railway Engineering & Maintenance of Way Association, and many others.

LITERATURE.

American Society of Civil Engineers; Transactions of June 15, 1885, The Preservation of Timber by Octave Chanute and others.

W. Curtis; Timber Treatment, Treating Plants, New York Railroad Club, April 15, 1904.

O. Chanute; Preservative Treatment of Timber, Journal of Society of Western Engineers, April, 1900.

C. W. Berry, Superintendent Union Pacific Creosoting Works; Causes of Decay of Timber, Municipal Engineering, August, 1907.

Dr. Hermann von Schrenk; Timber Preservation, Proceedings of Western Railway Club, December 16, 1902.

Octave Chanute; Preservation of Timber, Journal Western Society of Engineers, June, 1900.

E. H. Bowser; The Preservation of Timber with Antiseptics, Journal of Association of Engineering Societies, April, 1905.

United States Forestry Service; Circulars Nos. 80, 97, 98, 101, 112, 115, 128 and 129.

Dr. Hermann von Schrenk and others; Specifications for Dead Oil of Coal Tar, Bulletin No. 93, American Railway Engineering & Maintenance of Way Association.

American Railway Engineering & Maintenance of Way Association, Bulletin No. 96.

Many other publications on this subject are recorded in the Engineering Index.

DISCUSSION.

President.—You have the printed report on this and I suppose you have all read and considered it in your own mind. Are there any remarks? We had a talk on the open tank method last night. Did that bring up any questions?

Mr. Cahill.—I presume this subject includes the ravages of the teredo as well as those of the elements, does it not?

President.—That was not specified in the subject, but I presume it would come under that heading.

Mr. Killam.—We have two pile bridges in which creosoted piles were put in thirty-one years ago. On these the bark was removed and they were treated by the Norfolk Creosoting works under pressure, an inspector being on the job all the time to insure perfect penetration. On an examination six years ago I found only twenty-two piles that the worms were eating and which had to be replaced with new piles. Last year we had another examination and had to replace 40 piles. Untreated piles would probably have lasted only ten or twelve years, so that I think that creosoting piles will make them last nearly twice as long. We have the two forms of teredo of which Mr. Cahill speaks, one of them boring a hole straight into the wood and the other eating round and round the pile until it is almost cut in two.

President.—If there is no further discussion on Preservation of Timber, we will pass to the next subject.

COALING STATIONS AND CINDER PITS.

(Standing Subject No. 6.)

No report and no discussion.

President.—This finished the regular list of subjects for report and discussion for this year.

LIST OF ANNUAL CONVENTIONS.

No.	Place.	Date.	Membership.
1	St. Louis, Mo.,	Sept. 25, 1891.	**60**
2	Cincinnati, Ohio.	Oct. 18–19, 1892.	**112**
3	Philadelphia, Pa.	Oct. 17–19, 1893.	**128**
4	Kansas City, Mo.,	Oct. 16–18, 1894.	**115**
5	New Orleans, La.,	Oct. 15–16, 1895.	**122**
6	Chicago, Ill.	Oct. 20–22, 1896.	**140**
7	Denver, Col.,	Oct. 19–21, 1897.	**127**
8	Richmond, Va.	Oct. 18–19, 1898.	**148**
9	Detroit, Mich.,	Oct. 17–18, 1899.	**148**
10	St. Louis, Mo.,	Oct. 16–18, 1900.	**143**
11	Atlanta, Ga.,	Oct. 15–17, 1901.	**171**
12	Minneapolis, Minn.,	Oct. 21–23, 1902.	**195**
13	Quebec, Canada,	Oct. 20–22, 1903.	**223**
14	Chicago, Ill.,	Oct. 18–20, 1904.	**293**
15	Pittsburg, Pa.,	Oct. 17–19, 1905.	**313**
16	Boston, Mass.,	Oct. 16–18, 1906.	**340**
17	Milwaukee, Wis.,	Oct. 15–17, 1907.	**341**
18	Washington, D. C.,	Oct. 20–22, 1908.	**368**

LIST OF OFFICERS OF THE ASSOCIATION OF RAILWAY SUPERINTENDENTS OF BRIDGES AND BUILDINGS FROM ITS ORGANIZATION TO THE YEAR 1908-1909.

Year.	1891-2.	1892-3.	1893-4.	1894-5.
President	O. J. Travis	H. M. Hall	J. E. Wallace	Geo. W. Andrews.
First Vice-President	H. M. Hall	J. E. Wallace	Geo. W. Andrews	W. A. McGonagle.
Second Vice-President	J. B. Mitchell	G. W. Hinman	W. A. McGonagle	L. K. Spafford.
Third Vice-President	James Stannard	N. W. Thompson.	L. K. Spafford	James Stannard.
Fourth Vice-President	G. W. Hinman	C. E. Fuller	E. D. Hines	Walter G. Berg.
Secretary	C. W. Gooch	S. F. Patterson	S. F. Patterson	S. F. Patterson.
Treasurer	George M. Reid	George M. Reid	George M. Reid	George M. Reid.
Executive Members	W. R. Damon	G. W. Andrews	Quintine McNab	James Stannard.
	G. W. Markley	Joseph M. Staten.	Aaron S. Markley	James H. Travis.
	W. A. McGonagle	J. M. Caldwell	Floyd Ingram	Joseph H. Cummin.
	G. W. McGehee	Quintine McNab	James Stannard	R. M. Peck.
	G. W. Turner	Floyd Ingram	James H. Travis	J. L. White.
	J. E. Wallace	Aaron S. Markley	Joseph H. Cummin	A. Shane.

Year.	1895-6.	1896-7.	1897-8.	1898-9.
President	W. A. McGonagle	James Stannard	Walter G. Berg	Joseph H. Cummin.
First Vice-President	L. K. Spafford	Walter G. Berg	Joseph H. Cummin	Aaron S. Markley.
Second Vice-President	James Stannard	Joseph H. Cummin	Aaron S. Markley.	C. C. Mallard.
Third Vice-President	Walter G. Berg	Aaron S. Markley	G. W. Hinman	Walter A. Rogers.
Fourth Vice-President.	Joseph H. Cummin	R. M. Peck	C. C. Mallard	Joseph M. Staten.
Secretary	S. F. Patterson	S. F. Patterson	S. F. Patterson	S. F. Patterson.
Treasurer	George M. Reid	N. W. Thompson	N. W. Thompson	N. W. Thompson.
Executive Members.	R. M. Peck	W. O. Eggleston	George J. Bishop	Wm. S. Danes.
	J. L. Whito	W M. Noon	C. P. Austin	J. H. Markley.
	A. Shane	Joseph M. Staten	M. Riney	W. O. Eggleston.
	Aaron S. Markley	George J. Bishop	Wm. S. Danes	R. L. Heflin.
	W. M. Noon	C. P. Austin	J. H. Markley	Frank W. Tanner.
	Joseph M. Staten	M. Riney	W. O. Eggleston	A. Zimmerman.

LIST OF OFFICERS OF THE ASSOCIATION OF RAILWAY SUPERINTENDENTS OF BRIDGES AND BUILDINGS FROM ITS ORGANIZATION TO THE YEAR 1908-1909.

YEAR.	1899-1900.	1900-1901.	1901-1902.	1902-1903.
President	Aaron S. Markley	W. A. Rogers	W. S. Danes	B. F. Pickering.
First Vice-President	Walter A. Rogers	W. S. Danes	B. F. Pickering	C. C. Mallard.
Second Vice-President	Joseph M. Staten	B. F. Pickering	A. Shane	A. Shane.
Third Vice-President	Wm. S. Danes	A. Shane	A. Zimmerman	A. Zimmerman.
Fourth Vice-President	B. F. Pickering	A. Zimmerman	C. C. Mallard	A. Montzheimer.
Secretary	S. F. Patterson	S. F. Patterson	S. F. Patterson	S. F. Patterson.
Treasurer	N. W. Thompson.	N. W. Thompson	N. W. Thompson	N. W. Thompson.
Executive Members	T. M. Strain	T. M. Strain	A. Montzheimer	W. E. Smith.
	R. L. Heflin	H. D. Cleaveland	W. E. Smith	A. W. Merrick.
	F. W. Tanner	F. W. Tanner	A. W. Merrick	C. P. Austin.
	A. Zimmerman	A. Montzheimer	C. P. Austin	C. A. Lichty.
	H. D. Cleaveland	W. E. Smith	C. A. Lichty	W. O. Eggleston.
	A. Montzheimer	A. W. Merrick	W. O. Eggleston	J. H. Markley.

YEAR.	1903-1904.	1904-1905.	1905-1906.	1906-1907.
President	A. Montzheimer	C. A. Lichty	J. B. Sheldon	J. H. Markley.
First Vice-President	A. Shane	J. B. Sheldon	J. H. Markley	R. H. Reid.
Second Vice-President	C. A. Lichty	J. H. Markley	R. H. Reid	J. P. Canty.
Third Vice-President	J. B. Sheldon	R. H. Reid	R. C. Sattley	H. Rettinghouse.
Fourth Vice-President	J. H. Markley	R. C. Sattley	J. P. Canty	F. E. Schall.
Secretary	S. F. Patterson	S. F. Patterson	S. F. Patterson	S. F. Patterson.
Treasurer	C. P. Austin	C. P. Austin	C. P. Austin	C. P. Austin.
Executive Members	R. H. Reid	W. O. Eggleston	H. Rettinghouse	W. O. Eggleston.
	W. O. Eggleston	A. E. Killam	A. E. Killam	A. E. Killam.
	A. E. Killam	H. Rettinghouse	J. S. Lemond	J. S. Lemond.
	R. C. Sattley	J. S. Lemond	C. W. Richey	C. W. Richey.
	H. Rettinghouse.	W. H. Finley	H. H. Eggleston	H. H. Eggleston.
	J. S. Lemond	C. W. Richey	F. E. Schall	B. J. Sweatt.

Year.	1907-1908.	1908-1909.	1909-1910.	1910-1911.
President	R. H. Reid	J. P. Canty		
First Vice-President	J. P. Canty	H. Rettinghouse		
Second Vice-President	H. Rettinghouse	F. E. Schall		
Third Vice-President	F. E. Schall	J. S. Lemond		
Fourth Vice-President	W. O. Eggleston	A. E. Killam		
Secretary	S. F. Patterson	S. F. Patterson		
Treasurer	C. P. Austin	C. P. Austin		
Executive Members	A. E. Killam	J. N. Penwell		
	J. S. Lemond	Willard Beahan		
	C. W. Richey	F. B. Sheetar		
	Thomas S. Leake	W. H. Finley		
	W. H. Finley	T. L. D. Hadwen		
	J. N. Penwell	T. J. Fullem		

CONSTITUTION.

ARTICLE I.

NAME.

SECTION 1. This Association shall be known as the American Railway Bridge & Building Association.

ARTICLE II.

OBJECT.

SECTION 1. The object of this Association shall be the advancement of knowledge pertaining to the principles, design, construction and maintenance of railway bridges, buildings and other structures, by investigation, reports and discussion of the experience of its members and others, and to provide a means of exchange of ideas, so that bridge and building practice may be systematized and improved.

SECT. 2. The Association shall neither endorse nor recommend any particular patents, materials or supplies, but individual opinions of members may be expressed and appear in the proceedings.

ARTICLE III.

MEMBERSHIP.

SECTION 1. The membership of this Association shall consist of two classes, Active and Life Members.

SECT. 2. A person who is actively engaged in railway service in a responsible position, in charge of work connected with the construction or maintenance of railway bridges and buildings or other structures, or a professor of engineering, government timber expert, or railroad architect shall be eligible for active membership upon application to the secretary, and the payment of three dollars membership fee, and two dollars for one year's dues.

SECT. 3. Any member elected a life member of this Association shall have all the privileges of an active member, but shall not be required to pay annual dues. To be elected a life member he must have been a member of the Association at least five years and before being elected must have been pensioned by the railway company for which he worked or shall have retired from active railway service.

SECT. 4. Any member guilty of dishonorable conduct, or conduct unbecoming a railroad official and member of this Association, or who shall refuse to obey the chairman, or rules, may be expelled by a two-thirds vote of the members present.

SECT. 5. Membership shall continue until written resignation is received by the secretary, unless member has been previously expelled.

ARTICLE IV.

OFFICERS.

SECTION 1. The officers of this Association shall be a president, four vice-presidents, a secretary, a treasurer, and six executive members.

SECT. 2. The executive members, together with the president, vice-presidents, secretary and treasurer, shall constitute the Executive Committee.

SECT. 3. Past-Presidents of this Association who continue to be members shall be entitled to be present at all meetings of the Executive Committee, of which meetings they shall receive due notice, and be permitted to discuss all questions and to aid said committee by their advice and counsel; but said Past-Presidents shall not have a right to vote, nor shall their presence be requisite in order to constitute a quorum.

SECT. 4. Vacancies in any office for the unexpired term shall be filled by the Executive Committee without unnecessary delay.

ARTICLE V.

EXECUTIVE COMMITTEE.

SECTION 1. The Executive Committee shall exercise a general supervision over the financial interests of the Association, assess the amount of annual and other dues, call, prepare for and conduct general or special meetings, make all necessary purchases and contracts required to conduct the general business of the Association, but shall not have the power to render the Association liable for any debt beyond the amount then in the Treasurer's hands not subject to other prior liabilities. All appropriations for special purposes must be acted upon at a regular meeting of the Association.

SECT. 2. Two thirds of the members of the Executive Committee may call special meetings, thirty days' notice being given members by mail.

SECT. 3. Five members of the Executive Committee shall constitute a quorum for the transaction of business.

ARTICLE VI.

ELECTION OF OFFICERS AND TENURE OF OFFICE.

SECTION 1. The officers, excepting as otherwise provided, shall be elected at the regular meeting of the Association, held on the third Tuesday in October of each year, and the election shall not be postponed except by unanimous consent.

SECT. 2. The president and treasurer shall be elected by ballot by a majority of votes cast, and shall hold office for one year or until successors are elected. No member in arrears shall be eligible for office, and the President shall not be eligible for re-election.

Vice-Presidents and Executive Members.

SECT. 3. The vice-presidents shall hold office for one year and executive members for two years; four vice-presidents and three executive members to be elected each year; all officers herein named to hold office until successors are chosen.

SECT. 4. In the election of vice-presidents, each one shall be elected by a majority vote. Executive members shall be elected in the same way, all voting to be by written ballots.

Secretary.

SECT. 5. A secretary shall be elected by a majority of the votes of the members present at the annual meeting. The term of office of the secretary shall be for one year, unless terminated sooner by action of the Executive Committee, two thirds of whom may remove the secretary at any time. His compensation shall be fixed by a majority of the Executive Committee. The secretary shall also be secretary of the Executive Committee.

Treasurer.

SECT. 6. The treasurer shall be required to give bond in an amount to be fixed by the majority of the Executive Committee.

ARTICLE VII.

COMMITTEES.

SECTION 1. At the first session of the annual meeting the president shall appoint a committee of three members, not officers of the Association, who shall send names of nominees for officers of the Association for the ensuing year to the secretary, before the election of officers is in order, and the names shall be announced as soon as received. The assignment shall be such that at least two members shall have served on the committee during the previous year. The election shall not be held until the day after announcement, except by unanimous consent. Nothing in this section shall be construed to prevent any members from making nominations.

Auditing Committees.

SECT. 2. At the first session of each annual meeting there shall be appointed by the president an auditing committee of three members, not officers of the Association, whose duty it shall be to examine the accounts and vouchers of the secretary and treasurer and certify as to the correctness of their accounts. Acceptance of this committee's report will be regarded as the discharge of the committee.

Committee on Subjects for Discussion.

SECT. 3. At the annual meeting there shall be appointed, by the president, a committee, whose duty it shall be to prepare and report subjects for investigation and discussion at the next annual meeting. It shall be the duty of the committee to receive from members questions for discussion during the time set apart for that purpose. This committee shall decide whether such questions are suitable ones for dicussion, and if approved, report them to the Association.

Committees on Investigation.

SECT. 4. When the committee on subjects has reported and the Association approved of the same, the president shall appoint special committees to investigate and report on said subjects and he may appoint a special committee to investigate and report on any subject of which a majority of members present may approve.

Publication Committee.

SECT. 5. After each annual meeting the Executive Committee shall appoint a publication committee of three active members whose duty it shall be to supervise the publication of the proceedings. The assignment of this committee shall be such that at least one member shall have served on the committee during the previous year. The publication committee will report to the president and perform their duties under his supervision.

ARTICLE VIII.

ANNUAL DUES.

SECTION 1. Every active member shall pay to the secretary three dollars membership fee and shall also pay two dollars per year in advance to defray the necessary expenses of the Association. No member being one year in arrears for dues shall be entitled to vote at any election, and any member one year in arrears may be stricken from the list of members at the discretion of the Executive Committee.

ARTICLE IX.

AMENDMENTS.

SECTION 1. This constitution may be amended at any regular meeting by a two thirds vote of members present, provided that a written notice of the proposed amendment, or amendments, has been given at least sixty days previous to said regular meeting.

BY-LAWS.

TIME OF MEETING.

1. The regular meeting of this Association shall be held annually on the third Tuesday in October.

HOUR OF MEETING.

2. The regular hour of meeting shall be at 10 o'clock a. m., unless changed by order of the presiding officer.

PLACE OF MEETING.

3. The cities or places for holding the annual convention may be proposed at any regular meeting of the Association before the final adjournment. The places proposed shall be submitted to a ballot vote of the members of the Association, the city or place receiving a majority of all the votes cast to be declared the place of the next annual meeting; but if no place received a majority of all votes, then the place receiving the lowest number of votes shall be dropped on each subsequent ballot until a place is chosen.

QUORUM.

4. At the regular meeting of the Association, fifteen or more members shall constitute a quorum.

ORDER OF BUSINESS.

5. 1st—Calling of roll.
2nd—Reading minutes of last meeting.
3rd—Admission of new members.
4th—President's address.
5th—Reports of secretary and treasurer.
6th—Payment of annual dues.
7th—Appointment of committees.
8th—Reports of committees.
9th—Unfinished business.
10th—New business.
11th—Reading and discussion of questions propounded by members.
12th—Miscellaneous business.
13th—Election of officers.
14th—Adjournment.

DUTIES OF OFFICERS.

6. The president shall have general supervision of the affairs of the Association. He shall preside at all meetings of the Association, and of the Executive Committee, at which he may be present; shall appoint all committees not otherwise provided for,

and shall be ex-officio member of all committees. He shall, with the secretary, sign all contracts or other written obligations of the Association which have been approved by the Executive Committee.

At the annual meeting the president shall present a report containing a statement of the general condition of the Association, and an address.

7. The vice-presidents in order of seniority shall preside at meetings in the absence of the president, and discharge his duties in case of a vacancy in his office.

8. It shall be the duty of the secretary to keep a correct record of proceedings of all meetings of this Association; to keep correct all accounts between this Association and its members; collect all moneys due the Association, and pay the same over to the treasurer and take his receipt therefor, and to perform such other duties as the Association may require.

9. The treasurer shall receive all moneys and deposit the same in the name of the Association and shall receipt to the secretary therefor. He shall invest all funds not needed for current disbursements as shall be ordered by the Executive Committee. He shall pay all bills, when properly certified and approved by the president, and make such reports as may be called for by the Executive Committee.

DECISIONS.

10. The votes of a majority of members present shall decide any question, motion or resolution which shall be brought before the Association, unless otherwise provided.

DISCUSSIONS.

11. All discussions shall be governed by Roberts' Rules of Order.

DIRECTORY OF MEMBERS.

ASSOCIATION OF RAILWAY SUPERINTENDENTS OF BRIDGES AND BUILDINGS.

OCTOBER, 1908.

A

Agaard, P., Ill., Cent. R. R., Chicago, Ill.

Aldrich, Grosvenor, N. Y., N. H. & H. R. R., Readville, Mass.

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Van der Hoek, J., Div. Engr., L. V. R. R., Buffalo, N. Y.

W

Wackerle, L. J., Insp., Mo. Pac. Ry., St. Louis, Mo.

Walden, H. A., C. & N. W. Ry., Boone, Ia.

WALKER, I. O., Asst. Engr., N. C. & St. L. Ry., Paducah, Ky.

WATSON, P. N., Maine Central R. R., 5 Noble St., Brunswick, Me.

WEBSTER, J. T., M. C. R. R., Canada Div., St. Thomas, Ont.

WEISE, FRED E., C., M. & St. P. Ry., 1359 Railway Exchange, Chicago, Ill.

WELCH, E. T., C., St. P., M & O. Ry., Mankato, Minn.

WELKER, GEORGE W., Southern Ry., Alexandria, Va.

WELLS, J. M., A., T. & S. F. Ry., Chillicothe, Ill.

WENNER, E. R., L. V. R. R., Wilkesbarre, Pa.

WHEATON, L. H., Chief Engr., Halifax & So. Western Ry., Bridgewater, N. S.

WHITE, I. F., Div. Engr., C., H. & D. Ry., Dayton, O.

WHITE, J. B., C. & N. W. Ry., Boone, Ia.

WILKINSON, JOHN M., Cin. Northern R. R., 702 N. Washington St., Van Wert, O.

WILKINSON, W. H., Bridge Insp., Erie R. R., 464 Lyon St., Elmira, N. Y.

WILLIAMS, ARTHUR, Engr., Wellington & Manawata Ry., Wellington, N. Z.

WILLIAMS, M. R., A., T. & S. F. Ry., Las Vegas, N. M.

WILSON, E. E., N. Y. C. & H. R. R. R., 81 E. 125th St., New York City.

WINTER, A. E., 1913 Sixth Ave., Spokane, Wash.

WINTER, J. L., Seaboard Air Line Ry., Waldo, Fla.

WITT, C. C., Engr. Railway Appraisals, Sioux Falls, S. D.

WOOD, WM. E., Div. Engr., C., M. & St. P. Ry., Marion, Iowa.

WOLF, A. A., C., M. & St. P. Ry., Milwaukee Depot, Milwaukee, Wis.

WRIGHT, G. A., C. & E. I. R. R., Danville, Ill.

WRIGHT, C. W., L. I. R. R., Jamaica, N. Y.

Y

YAPPEN, ADOLPH, C., M. & St. P. Ry., Chicago, Ill.

YERANCE, WM. B., C. E., 418 Center St., South Orange, N. J.

YOUNG, ROSCOE C., Chief Engr., Lake Superior & I. Ry., M. & S. E. Ry., Marquette, Mich.

Z

Zinck, K. J. C., Asst. Engr., Grand Trunk Pacific Ry., Montreal, Que.

Zinsmeister, E. C., B. & O. R. R., Zanesville, O.

Zook, D. C., Penn. Lines West of Pittsburg, Ft. Wayne, Ind.

LIFE MEMBERS.

Crane, **Henry**, C. & N. W. Ry., Janesville, Wis.

Cummin, **Joseph** H., Bay Shore, N. Y.

Fletcher, **Holland** W., 1813 Termon Ave., Allegheny, Pa.

Foreman, **John**, Phila. & Read. R. R., Pottstown, Pa.

Green, E. H. R., Tex. Mid. R. R., Terrell, Tex.

McIntyre, **James**, 316 Boulevard, Miami, Fla.

Morrill, H. P., C. & N. W. Ry., Madison, Wis.

Phillips, **Henry** W., N. Y., N. H. & H. R. R., So. Braintree, Mass.

Porter, L. H., N. Y., N. H. & H. R. R., Franklin, Mass.

Travis, O. J., Beverly Dell Ranch, R. F. D. No. 1, Box 72, Bow, Wash.

Vandegrift, C. W., C. & O. Ry., Ronceverte, W. Va.

Walden, W. D., C. & N. W. Ry., Clinton, Ia.

Wise, E. F., Ill. Cent. R. R., Waterloo, Ia.

Active Members	355
Life Members	13
Total.	368

DECEASED MEMBERS.

Berg, **Walter** G., L. V. R. R., New York City.

Brady, **James** C., R. I. & P. Ry., Davenport, Ia.

DeMars, **James**, Wheeling & L. Erie R. R., Norwalk, Ohio.

Dunlap, H., Wabash R. R., Andrews, Ind.

Fuller, C. E., T. H. & I. R. R., Terre Haute, Ind.

Graham, T. B., Nor. Pac. Ry., Little Falls, Minn.

Hall, H. M., O. & M. Ry., Olney, Ill.

Hinman, G. W., Louisville & Nashville R. R., Evansville, Ind.
Humphreys, Thomas, So. Pac. Co., Bakersfield, Cal.
Isadell, L. S., O. & M. R. R., Lawrenceburg, Ind.
Keen, Wm. H., N. Y., N. H. & H. R. R., Hartford, Conn.
Lantry, J. F., N. Y. C. & H. R. R. R., Weehawken, N. J.
Lovett, J. W., Southern Ry., Atlanta, Ga.
Markley, Abel S., Pittsburg & Western Ry. Co., Allegheny, Pa.
McCormack, J. W., C., St. P., M. & O. Ry., Altoona, Wis.
McGehee, G. W., Mobile & Ohio R. R., Okolona, Miss.
Milliner, S. S., B. & O. S. W. Ry., Washington, Ind.
Mitchell, J. B., C., C., C. & St. L. Ry., Indianapolis, Ind.
Mitchell, W. B., N. Y., P. & O. R. R., Galion, Ohio.
Morgan, T. H., Gulf, Col. & S. F. Ry., Cleburne, Tex.
Peck, R. M., Missouri Pac. & St. L., I. M. & S. Ry., Pacific, Mo.
Reid, George M., L. S. & M. S. Ry., Cleveland, Ohio.
Reynolds, Edward F., C. & N. W. Ry., Antigo, Wis.
Schwartz, John C., C., St. P., M. & O. Ry., Emerson, Neb.
Spafford, L. K., K. City, Fort Scott & Memphis Ry., Kansas City, Mo.
Spangler, J. A., B. & O. Ry., Washington, Pa.
Taylor, J. W., Terminal R. R. Association of St. Louis, St. Louis, Mo.
Thompson, N. W., P., F. W. & C. Ry., Ft. Wayne, Ind.
Tozzer, William S., C. & O. R. R., Cincinnati, Ohio.
Trautman, J. J., S. C. R. R., Edgefield, S. C.
Wallace, J. E., Wabash R. R., Springfield, Ill.
Worden, C. G., S. F. Pac. R. R., Winslow, Ariz.

MEMBERSHIP AND MILEAGE OF RAILWAYS REPRESENTED IN THE AMERICAN RAILWAY, BRIDGE AND BUILDING ASSOCIATION.

Name of Road and Membership.	Members.	Mileage.
A. Q. & W. Railway of Canada	1	20
J. V. Nemmo, Paspebiac, Que.		
Atchison, Topeka & Santa Fé Railway	6	5,563
F. M. Clough, San Marcial, N. M.		
J. D. Gilbert, Topeka, Kan.		
E. McCann, Wellington, Kan.		
John L. Talbott, Pueblo, Col.		
J. M. Wells, Chillicothe, Ill.		
M. R. Williams, Las Vegas, N. M.		
Atchison, Topeka & Santa Fé Railway (Coast Lines)	4	1,980
R. J. Arey, San Bernardino, Cal.		
E. E. Ball, Winslow, Ariz.		
J. F. Parker, San Bernardino, Cal.		
D. A. Shope, Fresno, Cal.		
Atlanta & West Point Railroad, and Western Railway of Alabama	1	225
O. T. Nelson, Montgomery, Ala.		
Baltimore & Ohio Railroad, and B. & O. S. W. R. R.	9	4,422
G. W. Andrews, Baltimore, Md.		
W. M. Clark, Glenwood, Pa.		
W. T. Hopke, Grafton, W. Va.		
J. T. McIlwain, Akron, O.		
William Renton, Garrett, Ind.		
W. F. Strouse, Washington, D. C.		
S. C. Tanner, Baltimore, Md.		
Wm. Trapnell, Baltimore, Md.		
E. C. Zinsmeister, Zanesville, O.		

Name of Road and Membership.	Members.	Mileage
Bangor & Aroostook Railroad	2	521
W. E. Alexander, Houlton, Me.		
M. Burpee, Houlton, Me.		
Beaumont, Sour Lake & Western R. R.	1	428
Colorado Southern, N. O. & Pac. R. R.		
Orange & Northwestern R. R.		
C. H. Fisk, Beaumont, Tex.		
Bessemer & Lake Erie Railroad	1	216
H. D. Cleaveland, Greenville, Pa.		
Boston & Maine Railroad	16	2,288
Cyrus P. Austin, Medford, Mass.		
C. C. Battey, Concord, N. H.		
J. P. Canty, Fitchburg, Mass.		
John Ewart, Boston, Mass.		
Andrew B. Hubbard, Boston, Mass.		
F. J. Leavitt, Sanbornville, N. H.		
William A. Lydston, Salem, Mass.		
John Marsh, Lawrence, Mass.		
Albert Mountfort, Nashua, N. H.		
A. A. Page, Boston, Mass.		
S. F. Patterson, Concord, N. H.		
B. F. Pickering, Sanbornville, N. H.		
Fred C. Rand, Boston, Mass.		
F. A. Sherwin, Springfield, Mass.		
J. P. Snow, Boston, Mass.		
E. C. Spaulding, St. Johnsbury, Vt.		
Canada Atlantic Railway	1	468
George A. Mountain, Ottawa, Ont.		
Canadian Pacific Railway	3	9,230
F. P. Gutelius, Montreal, P. Q.		
C. N. Monsarrat, Montreal, P. Q.		
P. B. Motley, Montreal, P. Q.		
Carolina, Clinchfield & Ohio Ry	1	101
W. F. Steffens, Johnson City, Tenn.		
Central of Georgia Railway	1	1,913
H. C. McKee, Macon, Ga.		

Name of Road and Membership.	Members.	Mileage.
Central Railroad of New Jersey...............	2	646
A. L. Bowman, N. Y. City.		
George F. Morse, New York City.		
Central Vermont Railway.....................	4	536
J. E. Cole, St. Albans, Vt.		
C. F. Flint, St. Albans, Vt.		
H. E. Holmes, New London, Conn.		
G. J. Patterson, Waterbury, Vt.		
Chesapeake & Ohio Railway..................	3	1,644
J. M. Staten, Richmond, Va.		
C. W. Vandegrift, Ronceverte, W. Va.		
Oscar L. Grover, Richmond, Va.		
Chicago & Eastern Illinois Railroad...........	2	957
A. S. Markley, Danville, Ill.		
G. A. Wright, Danville, Ill.		
Chicago & North Western Railway............	32	7.550
L. J. Anderson, Escanaba, Mich.		
F. L. Burrell, Fremont, Neb.		
Henry Crane (retired), Janesville, Wis.		
H. H. Decker, Winona, Minn.		
T. H. Durfee, Huron, S. D.		
W. H. Finley, Chicago, Ill.		
M. J. Flynn, Chicago, Ill.		
John Hunciker, Chicago, Ill.		
Lee Jutton, Chicago, Ill.		
C. F. King, Shoshoni, Wyo.		
C. A. Lichty, Chicago, Ill.		
George Loughnane, Mason City, Ia.		
W. T. Main, Chicago, Ill.		
C. A. Marcy, Chicago, Ill.		
A. W. Merrick, Boone, Ia.		
J. D. Moen, Boone, Ia.		
H. P. Morrill (retired), Madison, Wis.		
H. Rettinghouse, Boone, Ia.		
John Rhoads; Chicago, Ill.		
M. Riney, Baraboo, Wis.		
J. S. Robinson, Chicago, Ill.		
D. Rounseville, Kaukauna, Wis.		
A. R. Shedd, Chicago, Ill.		

Name of Road and Membership.	Members.	Mileage.
Chicago & North Western Railway, *Continued.*		
Wm. Spencer, Chardon, Neb.		
I. F. Stern, Chicago, Ill.		
W. Sweeney, Fond du Lac, Wis.		
L. H. Taylor, Chicago, Ill.		
W. J. Towne, Chicago, Ill.		
H. M. Trippe, Chicago, Ill.		
H. A. Walden, Boone, Ia.		
W. D. Walden (retired), Clinton, Ia.		
J. B. White, Boone, Ia.		
Chicago, Burlington & Quincy R. R.	4	9,022
Geo. Fenney, McCook, Neb.		
Ed M. Gilchrist, Centerville, Ia.		
W. Hurst, St. Joseph, Mo.		
J. O. Thorne, Beardstown, Ill.		
Chicago Great Western Ry.	1	1,367
W. B. Causey, Chicago, Ill.		
Chicago, Indianapolis & Louisville Railway	1	592
J. M. Caldwell, Lafayette, Ind.		
Chicago, Lake Shore & Eastern Railway	1	308
C. Thompson, Chicago, Ill.		
Chicago, Milwaukee & St. Paul Railway	12	7,808
(And C. M. & St. P. Ry. Coast Lines.)		
E. J. Auge, Wells, Minn.		
A. G. Bennett, Minneapolis, Minn.		
H. R. Drum, Chamberlain, S. D.		
T. L. D. Hadwen, Chicago, Ill.		
F. E. King, Milwaukee, Wis.		
N. H. LaFountain, Chicago, Ill.		
C. F. Loweth, Chicago, Ill.		
William Ross, Millbank, S. D.		
Fred E. Weise, Chicago, Ill.		
William E. Wood, Marion, Ia.		
A. A. Wolf, Milwaukee, Wis.		
A. Yappen, Chicago, Ill.		
Chicago, Rock Island & Pacific Railway	4	7,513
E. R. Floren, Fairbury, Neb.		
B. M. Hudson, Ft. Worth, Tex.		
J. D. Upp, Colorado Springs, Col.		
McClellan Bishop, El Reno, Okla.		

Name of Road and Membership.	Members.	Mileage.
Chicago, St. Paul, Minneapolis & Omaha Railway	3	1,729
G. Larson, Spooner, Wis.		
W. B. Rogers, Emerson, Neb.		
E. T. Welch, Mankato, Minn.		
Chicago Terminal Transfer Railroad	1	280
E. N. Layfield, Chicago, Ill.		
Cincinnati, Hamilton & Dayton Railway	2	1,038
J. W. Anderson, Chillicothe, O.		
I. F. White, Dayton, O.		
Cincinnati Northern Railroad	1	236
J. M. Wilkinson, Van Wert, O.		
Colorado & Southern Railway	2	1,272
Harry James, Denver, Col.		
W. T. Powell, Denver, Col.		
Colorado Springs & Cripple Creek Dist. Ry	1	105
B. A. Briggs, Cripple Creek, Col.		
Denver, Enid & Gulf Railroad	1	120
J. D. Lacy, Enid, Okla.		
Duluth & Iron Range R. R.	2	168
W. A. Clark, Duluth, Minn.		
B. T. McIvers, Two Harbors, Minn.		
Duluth, Missabe & Northern Railway	1	275
W. A. McGonagle, Duluth, Minn.		
Duluth, South Shore & Atlantic Railway	1	586
W. M. Noon, Marquette, Mich.		
Elgin, Joliet & Eastern Railway	1	206
A. Montzheimer, Joliet, Ill.		
El Paso & Southwestern System	1	810
Bailey J. Mustain, El Paso, Tex.		
Erie Railroad (and Chicago & Erie)	4	2,439
W. O. Eggleston, Huntington, Ind.		
Fred A. Knapp, Jersey City, N. J.		
Neil McLean, Huntington, Ind.		
W. H. Wilkinson, Elmira, N. Y.		

Name of Road and Membership.	Members.	Mileage.
Florida East Coast Railway	1	580
E. K. Barrett, St. Augustine, Fla.		
Fort Smith & Western Railway	1	217
B. F. Beckman, Ft. Smith, Ark.		
Galveston, Harrisburg & San Antonio Railway and Texas & New Orleans Railroad	1	1,786
C. A. Thanheiser, Houston, Tex.		
Gila Valley, Globe & Northern Railway	1	125
C. C. Mallard, Globe, Ariz.		
Grand Rapids & Indiana Railway	2	582
W. S. McKeel, Grand Rapids, Mich.		
H. M. Large, Ft. Wayne, Ind.		
Grand Trunk Railway System	2	4,644
A. Findley, Montreal, P. Q.		
George A. Mitchell, Toronto, Ont.		
Grand Trunk Pacific Railway	1	2,440
K. J. C. Zinck, Montreal, Que.		
Great Northern Ry	1	6,687
James E. Nelson, Sioux City, Ia.		
Gulf, Colorado and Santa Fé Railway	1	1,515
E. C. George, Beaumont, Tex.		
Halifax & Southwestern Railway	1	369
L. H. Wheaton, Bridgewater, N. S.		
Illinois Central Railroad	10	4,371
P. Agaard, Chicago, Ill.		
C. C. Bean, Freeport, Ill.		
F. O. Draper, Chicago, Ill.		
T. J. Fullem, Chicago, Ill.		
R. J. McKee, Carbondale, Ill.		
Samuel P. Munson, Mattoon, Ill.		
William Reed, Jr., Vandalia, Ill.		
C. E. Thomas, Cent. Sta., Chicago, Ill.		
F. L. Thompson, Chicago, Ill.		
E. F. Wise (retired), Waterloo, Ia.		
Illinois Southern Railway	1	135
G. O. Lilly, Sparta, Ill.		
Illinois Traction System	1	438
H. D. Perkins, Decatur, Ill.		

Name of Road and Membership.	Members.	Mileage.
Intercolonial Railway	8	1,449
T. C. Burpee, Moncton, N. B.		
John Forbes, Moncton, N. B.		
Hugh Jardine, Moncton, N. B.		
A. E. Killam, Moncton, N. B.		
H. J. McGrath, Moncton, N. B.		
W. B. McKenzie, Moncton, N. B.		
Thomas Sefton, Moncton, N. B.		
A. C. Selig, Moncton, N. B.		
International & Great Northern Railway	1	1,106
H. M. Jack, Palestine, Tex.		
Kansas City, Clinton & Springfield Railway	1	155
J. B. Brown, Clinton, Mo.		
Lake Erie & Western Railway	1	719
J. N. Penwell, Tipton, Ind.		
Lake Shore & Michigan Southern Railway	4	1,529
Willard Beahan, Cleveland, O.		
Philip O'Neil, Adrian, Mich.		
R. H. Reid, Cleveland, O.		
J. L. Soisson, Norwalk, O.		
Lake Superior & Ishpening Ry., Munising Ry., and Marquette & S. E. Ry	2	160
August Anderson, Marquette, Mich.		
Roscoe C. Young, Marquette, Mich.		
Lehigh & Hudson River Railway	2	96
J. E. Barrett, Warwick, N. Y.		
Lewis A. Riley, Warwick, N. Y.		
Lehigh Valley Railroad	9	1,434
E. B. Ashby, 143 Liberty St., New York City.		
W. E. Harwig, Phillipsburg, N. J.		
R. L. Heflin, Sayre, Pa.		
Peter Hofecker, Sayre, Pa.		
Judson Joslin, Auburn, N. Y.		
David A. Keefe, Athens, Pa.		
F. E. Schall, South Bethlehem, Pa.		
J. Van der Hoek, Buffalo, N. Y.		
E. R. Wenner, Wilkesbarre, Pa.		

Name of Road and Membership.	Members.	Mileage.
Liberty-White Railroad	1	51
J. T. Burke, McComb, Miss.		
Long Island R. R.	2	392
C. F. Spencer, Jamaica, N. Y.		
C. W. Wright, Jamaica, N. Y.		
Louisville & Nashville Railroad	4	4,349
J. M. Bibb, Birmingham, Ala.		
R. O. Elliott, Columbia, Tenn.		
Floyd Ingram, Erin, Tenn.		
A. B. McVay, Evansville, Ind.		
Maine Central Railroad	1	920
P. N. Watson, Brunswick, Me.		
Mexican Central Railway	1	3,225
Hans Bentele, City of Mexico, Mexico.		
Michigan Central Railroad	5	1,745
S. D. Bailey, Detroit, Mich.		
Charles Carr, Jackson, Minn.		
Thomas Hall, St. Thomas, Ont.		
Henry A. Horning, Jackson, Mich.		
J. T. Webster, St. Thomas, Ont.		
Minneapolis & St. Louis Railroad	1	1,028
Ed. Gagnon, Minneapolis, Minn.		
Minneapolis, St. Paul & Sault Ste. Marie Railway	2	2,309
A. Amos, Minneapolis, Minn.		
P. Swenson, Minneapolis, Minn.		
Miss. River & Bonne Terre Railway	1	46
C. H. Fake, Bonne Terre, Mo.		
Missouri & North Arkansas R. R.	1	191
W. S. Dawley, St. Louis, Mo.		
Missouri, Kansas & Texas Railway	2	3,043
F. W. Bailey, Denison, Tex.		
J. G. Gossett, Denison, Tex.		

Name of Road and Membership.	Members.	Mileage.
Missouri Pacific Railway System	11	6,479
(Including St. L., I. M. & S.)		
Robert J. Bruce, St. Louis, Mo.		
W. R. Collier, Gorham, Ill.		
J. A. Costolo, St. Louis, Mo.		
F. W. Hausgen, Sedalia, Mo.		
U. A. Horn, Osawatomie, Kan.		
J. O. Potts, St. Louis, Mo.		
C. A. Sibley, St. Louis, Mo.		
F. B. Scheetz, St. Louis, Mo.		
Wm. Sullivan, Kansas City, Mo.		
F. W. Tanner, St. Louis, Mo.		
L. J. Wackerle, St. Louis, Mo.		
Mobile & Ohio Railroad	1	926
E. P. Hawkins, Murphysboro, Ill.		
Nashville, Chattanooga & St. Louis Railway	1	1,230
I. O. Walker, Paducah, Ky.		
New Orleans Terminal Co.	1	66
Frank G. Jonah, New Orleans, La.		
New South Wales Government Railways	1	3,280
James Fraser, Sydney, N. S. W.		
New York Central & Hudson River Railroad	8	2,829
William Kleefeld, Jr., Watertown, N. Y.		
G. J. Klumpp, Rochester, N. Y.		
R. P. Mills, 125th St., New York City.		
Kemper Peabody, Mott Haven, N. Y. City.		
W. A. Pettis, Rochester, N. Y.		
Edward Rykenboer, Rochester, N. Y.		
H. C. Thompson, Weehawken, N. J.		
E. E. Wilson, 125th St., New York City.		
New York, New Haven & Hartford Railroad	11	2,057
Grosvenor Aldrich, Readville, Mass.		
J. S. Browne, Providence, R. I.		
Wm. Graham, New Haven, Conn.		
Wm. H. Moore, New Haven, Conn.		
H. W. Phillips (retired), South Braintree, Mass.		
L. H. Porter (retired), Franklin, Mass.		
George A. Rodman, New Haven, Conn.		

Name of Road and Membership.	Members.	Mileage.
New York, New Haven & Hartford Railroad, *Continued.*		
George T. Sampson, Boston, Mass.		
W. B. Schuessler, New Haven, Conn.		
D. W. Sharpe, New London, Conn.		
J. B. Sheldon, Providence, R. I.		
New Zealand Government Railways	1	2,330
George A. Troup, Wellington, New Zealand.		
Norfolk & Southern Railway	1	598
Thomas W. Cothran, Greenwood, S. C.		
Northern Electric Railway	1	113
A. D. Schindler, San Francisco, Cal.		
Northern Pacific Railway	7	5,617
F. R. Bartles, Fargo, N. D.		
James Hartley, Staples, Minn.		
N. F. Helmers, Minneapolis, Minn.		
F. Ingalls, Jamestown, N. D.		
C. S. McCully, Jamestown, N. D.		
R. E. McFarlane, Duluth, Minn.		
J. C. Taylor, Glendive, Mont.		
North Western Govt. Rys. (India)	1	3,880
D. M. Cookson, Karachi, India.		
Oregon Short Line Railroad	1	1,455
A. H. King, Salt Lake City, Utah.		
Pennsylvania Lines West of Pittsburg	9	2,761
Samuel C. Bowers, Steubenville, O.		
Stanton Bowers, Bradford, O.		
S. Geary, Cambridge, O.		
B. F. Gehr, Richmond, Ind.		
C. M. Large, Jamestown, Pa.		
A. F. Miller, Chicago, Ill.		
D. G. Musser, Wellsville, O.		
H. H. Pollock, Carnegie, Pa.		
D. C. Zook, Fort Wayne, Ind.		
Pennsylvania Railroad	6	5,294
M. M. Barton, West Philadelphia, Pa.		
J. A. Blair, Pittsburg, Pa.		
Richard G. Develin, Philadelphia, Pa.		
H. R. Leonard, Philadelphia, Pa.		
Robert McKibbon, Altoona, Pa.		
C. W. Richey, Pittsburg, Pa.		

Name of Road and Membership.	Members.	Mileage.
Pennsylvania R. R. Tunnels	1	20
(New York & Long Island R. R.)		
R. D. Coombs, 10 Bridge St., New York City.		
Pere Marquette Railroad	2	2,398
G. E. Hanks, East Saginaw, Mich.		
A. McNab, Holland, Mich.		
Philadelphia & Reading Railway	4	1,491
Amos H. Beard, Reading, Pa.		
John Foreman (retired), Pottstown, Pa.		
W. W. Perry, Williamsport, Pa.		
E. G. Storck, Philadelphia, Pa.		
Pittsburg & Lake Erie Railroad	2	191
D. L. McKee, McKee's Rocks, Pa.		
G. H. Soles, Pittsburg, Pa.		
Queen & Crescent Route	1	338
E. L. Loftin, Vicksburg, Miss.		
Rutland Railroad	1	416
J. E. Johnson, Rutland, Vt.		
Seaboard Air Line Ry	2	2,611
M. F. Cahill, Jacksonville, Fla.		
J. L. Winter, Waldo, Fla.		
St. Joseph & Grand Island Railway	1	320
O. H. Andrews, St. Joseph, Mo.		
St. Louis, Iron Mountain & Southern (see Missouri Pacific System).		
St. Louis Southwestern Railway	2	1,451
J. S. Berry, Tyler, Tex.		
Wm. Quinn, Tyler, Tex.		
Southern Indiana Ry	1	351
James Duprees, Crete, Ill.		
Southern Railway	10	7,294
D. A. Ballenger, Greenville, S. C.		
James T. Carpenter, Princeton, Ind.		

Name of Road and Membership.	Members.	Mileage.
Southern Railway, *Continued.*		
G. W. Detter, Charleston, S. C.		
W. F. Fraylick, Charleston, S. C.		
J. R. Fowlkes, Columbia, S. C.		
Joseph A. Killian, Jr., Charlotte, N. C.		
J. S. Lemond, Charlotte, N. C.		
D. W. Lum, Washington, D. C.		
J. W. Morgan, Columbia, S. C.		
G. W. Welker, Alexandria, Va.		
Southern Pacific Company	10	5,971
T. W. Bratten, West Oakland, Cal.		
Frank V. Carman, West Oakland, Cal.		
R. M. Drake, San Francisco, Cal.		
James Gratto, Los Angeles, Cal.		
W. J. Mellor, Lafayette, La.		
P. N. Nelson, San Francisco, Cal.		
H. Pollard, San Francisco, Cal.		
George W. Rear, San Francisco, Cal.		
Daniel Robertson, West Oakland, Cal.		
L. D. Smith, Oakland, Cal.		
Tennessee Central R. R.	1	326
E. M. Carter, Nashville, Tenn.		
Texas & Gulf Ry.	1	74
K. S. Hull, Longview, Tex.		
Texas & Pacific Railway	1	1,885
E. Loughery, Marshall, Tex.		
Texas Midland Railroad	1	125
E. H. R. Green, Terrell, Tex.		
Toledo, Peoria & Western Railway	1	248
J. H. Markley, Peoria, Ill.		
Toledo, St. Louis & Western R. R.	1	450
H. H. Eggleston, Frankfort, Ind.		
Union Pacfic Railroad	2	3,033
J. L. Neff, Omaha, Neb.		
J. Parks, Denver, Col.		
Vandalia Railroad	1	821
J. L. McKee, Spencer, Ind.		

Name of Road and Membership.	Members.	Mileage.
Wabash Railroad	2	2,517
A. O. Cunningham, St. Louis, Mo.		
William S. Danes, Peru, Ind.		
Washington Terminal Co.	2	60
W. M. Cardwell, Washington, D. C.		
C. H. Spencer, Washington, D. C.		
Wellington & Manawata Railway (New Zealand)	1	84
Arthur Williams, Wellington, New Zealand.		
Western Australia Government Railways	2	1,540
W. J. George, Perth, Western Australia.		
E. S. Hume, Fremantle, Western Australia.		
Wisconsin Central Railway	2	1,022
Henry Bender, Fond du Lac, Wis.		
G. A. Manthey, Abbotsford, Wis.		
Yazo & Miss. Valley R. R.	2	1,239
D. H. Holdridge, Vicksburg, Miss.		
W. Shropshire, Greenville, Miss.		
Total	325	
Other members not connected with roads	43	
Total number of members	368	197,409

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American Bridge Co............................ XIX
American Railway Bridges and Buildings........ XXXVII
American Hoist & Derrick Co.................... II–III
American Valve and Meter Co.................. XXXI
Asbestos Protected Metal Co..................... XXIII
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Atlas Portland Cement Co. (The)................ XXIX
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The Anderson Automatic Water Service Valves

FOR RAILROADS

The Anderson Patent Controlling Altitude Valves

"ALWAYS CUSHIONED IN OPENING AND CLOSING"
"FOR HIGH AND LOW PRESSURE"

ADJUSTMENT FOR HIGH & LOW PRESSURE
GOLDEN-ANDERSON V.S.CO.
CONTROLLING ALTITUDE VALVE
PITTSBURG, PA.
INLET

For maintaining a uniform stage of water in Tank Reservoirs or Standpipes, doing away with the annoyance of tank fixtures. The Altitude Valve is placed under the tank or any other convenient place, where it will be accessible at all times and protected from frost, thus insuring the water supply, even in the coldest weather. **Valve closed automatically by water, also by electric attachment as desired.**

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For High and Low Pressure.
(Angle or Straight Way.)

Absolutely controls the water level in tanks or reservoirs. Instantly adjusted to operate quick or slow, as desired. **"No waste of water."** The upper portion of body being lined with bronze, also the valve or piston being solid bronze, makes the valve **indestructible.** Railroad men that use them say **"their equal is not made."**

Absolutely the only satisfactory float valve known.

"The Valves With an Absolute Guarantee"

OUR VALVES CAN BE CONNECTED DIRECT TO CITY MAINS

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"American" Bridge Erectors' Engine

HOISTING ENGINES *and* DERRICKS

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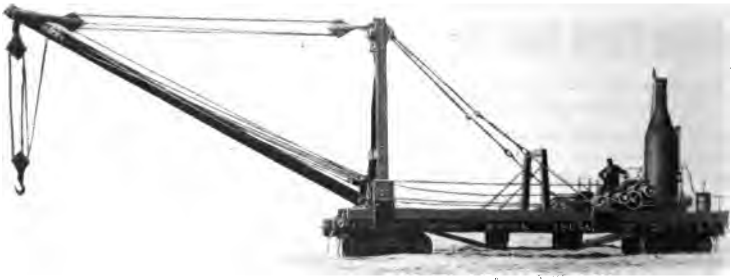

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AMERICAN HOIST & DERRICK COMPANY

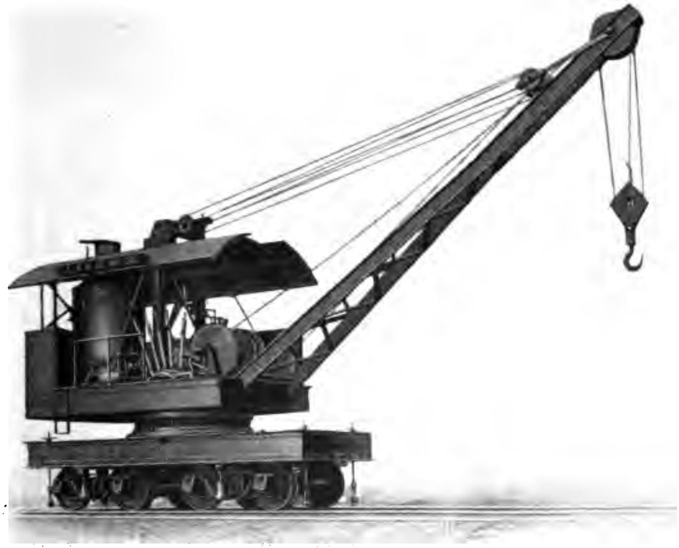
St. Paul, U. S. A.

Chicago New York Pittsburg New Orleans San Francisco

"AMERICAN"
LOCOMOTIVE CRANES

For Yard, Road and
Coaling Station
Service

With or without Grab Buckets



Write for Proposition "G"

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Chicago New York Pittsburg New Orleans San Francisco

Carey's Magnesia Flexible Cement Roofing

CA YS
M.F.C.
ROOFING
FINISHED PAINTED SURFACE
ASPHALT COMPOUND IMBEDDED INTO BURLAP
STRONG BURLAP IMBEDDED INTO CEMENT
SOLID FLEXIBLE BODY OF SPECIAL CEMENT COMPOSITION
HEAVY FOUNDATION OF WOOLEN FELT

"Famous for Durability"

The component parts of Carey's roofing, which are compressed into a solid, compact and absolutely water proof single sheet of Roofing.

CAREY'S is unlike any other roofing—better than any other. Imitators can't duplicate it because the Asphalt Cement Composition used in Carey's Roofing undergoes a secret process. Furthermore, the method of constructing Carey's Roofing is protected by United States patents.

Write for a sample and free booklet, which explains WHY *Carey's Roofing*—

IS FIRE RESISTING

Does not melt, rot, rust, dry out or lose its life or elasticity; Is proof against heat or cold; Is equally adapted to flat or steep surfaces; Never blows off; May be applied ***over*** **leaky shingles or metal roofs without expense of removal; Is easily laid by common labor; Makes excellent siding; And finally,** ***WHY Carey's Roofing is the most economical on the market.***

We take contracts to furnish and apply our roofing anywhere.

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OVER 40 BRANCHES

FAIRBANKS-MORSE

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Roller-Bearing and Ball-Bearing Bridge Jacks
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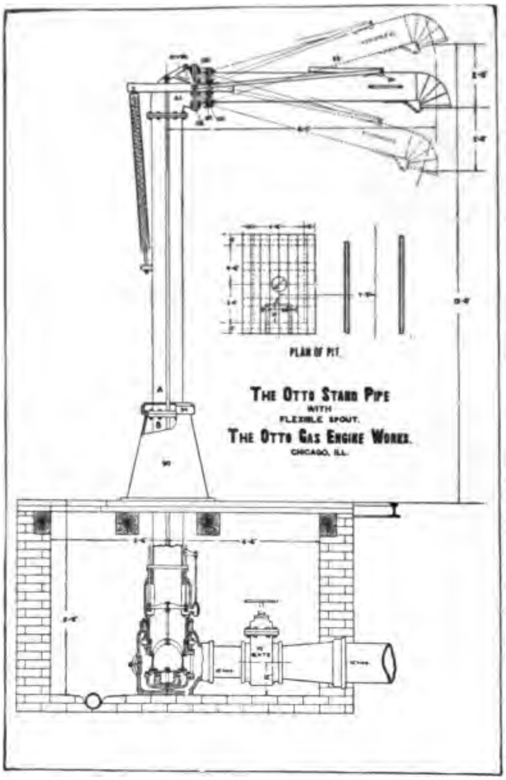

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Occupy Little Space.

Adapted to All Positions. Highest Award at the World's Fair.

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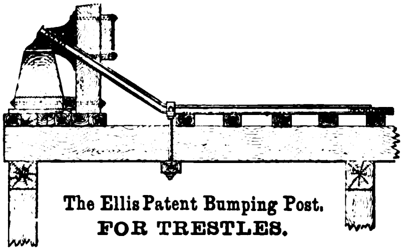

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FOR TRESTLES.

A TEST.

Shipped Complete with Directions for Erecting. Write for Circulars and Prices.

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The "B. & M. SPECIAL"
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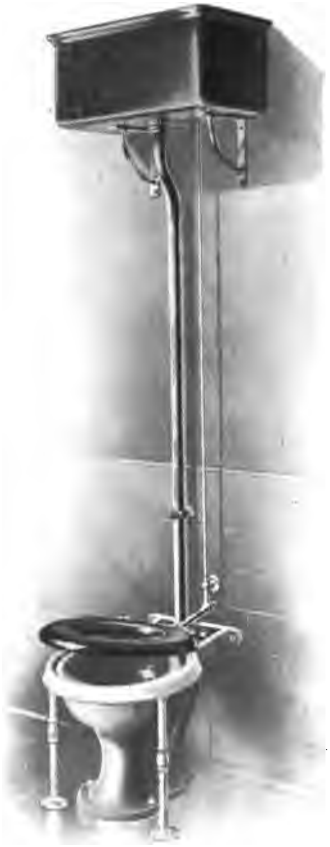

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Has a record of 17 years of highest efficiency.
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For all Structural Iron Work, Steel Cars, Bridges, etc.
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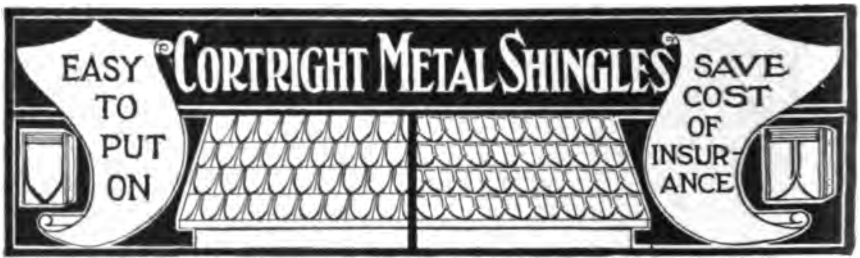

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Cement Paint

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Damp Proof Compounds

We are specialists in waterproofing steel trough, deck, stringer or tie bridges.

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An elastic finishing paint of great covering capacity. Used in conjunction with priming coat of MARINE TOCKOLITH.

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Established 1848

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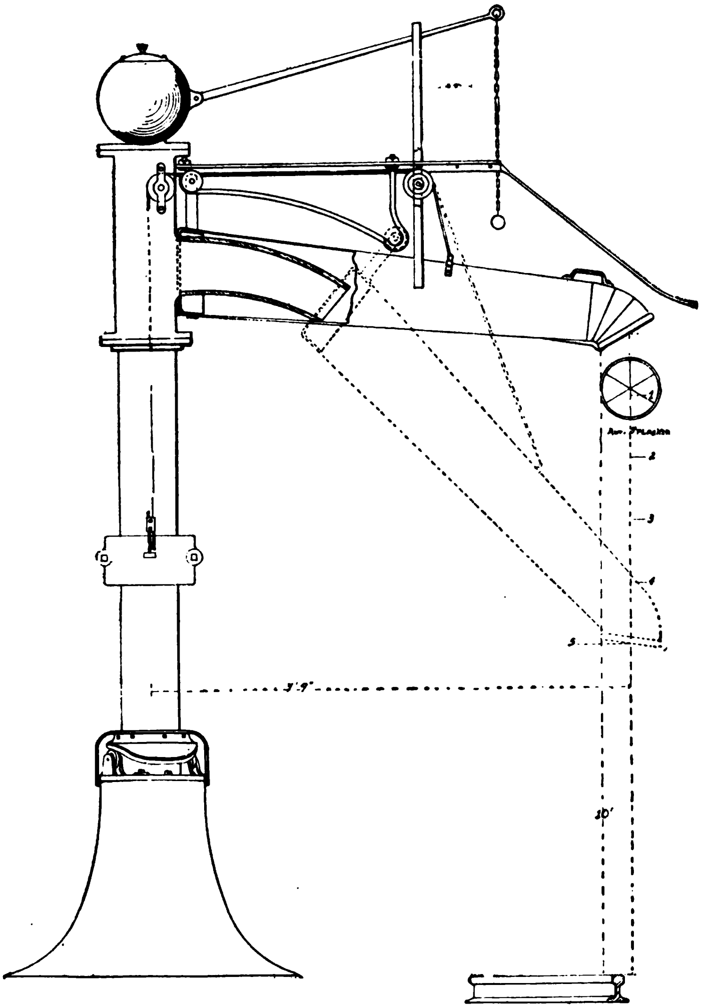

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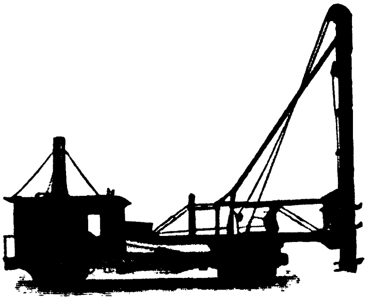

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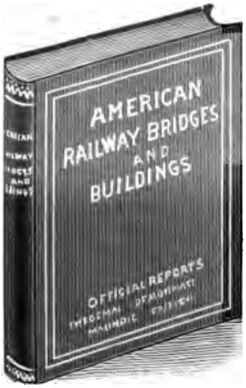

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